Light and Lighting

Vol. XLIV.—No. 12. December, 1951 One Shilling and Sixpence

Contents

	Page
Editorial	397
Notes and News ...	398
Fluorescent Lighting in a Cathedral	401
New Department Store in Plymouth	404
Lighting at the 1951 Motor Show	408
Building Research Congress ...	410
Steel Company of Wales ...	417
Medical Aspects of Light ...	423
New Lighting Installations ...	427
I.E.S. Activities	431
Postscript	436
Index for 1951	437
Index to Advertisers ...	xviii

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The official journal of the Illuminating Engineering Society.

Light and Life

CHRISTMAS is the festival of light—the winter's darkness is broken by firelight and by fairylights—and we are reminded that we may enjoy the beauty of light without having to worry about the mechanics of lighting.

The first created thing was energy, so simply recorded in the command," Let there be light," and, from man's earliest days, the word " light " has stood for the cheerful and enjoyable things in life. How fortunate is the lighting industry in having to deal with this exciting and romantic medium! How fortunate to have a daily task concerned with the means of seeing, the fundamental energy of the universe, an essential of life itself!

My Christmas wish for every reader is that the mundane details of illuminating engineering may never take away from us the enjoyment and thrill of light.

J. G. Holmes

President, I.E.S.

Notes and News

Awards to Students

The I.E.S. President recently expressed some concern that during the last few years the I.E.S. Silver Jubilee Commemoration Award has only once been awarded and that there had been so few entries for the award. It is, indeed, surprising that in the whole of the gas and electrical industries and out of the ranks of the architects, who jointly make up the lighting interests, there should be such reluctance on the part of students to make claim to this annual prize. This is no doubt largely due to the fact that the award is not as well known as it should be.

The award is available each year to any member, in any class, of the I.E.S. who is under twenty-six years of age, and may be made for the accomplishment of any of the following tasks: (1) the presentation in writing to any approved body of a paper dealing with the theory or practice of illuminating engineering, (2) the design and/or construction of a novel instrument or appliance for use in connection with an application of or research concerning illumination, or (3) the carrying out by the applicant of an investigation beneficial to illuminating engineering. The terms are therefore extremely wide and offer ample opportunity to those coming within the age limit.

The award consists of a certificate and a cheque for five guineas. The monetary value may not be high but the value of a competition or award should not be assessed by this alone, and we should like to see more of the younger men, and women, of whom there are quite a few in the Society, taking an interest in this side of the Society's activities and in their chosen profession by entering for this award which at present is the only one in the lighting industry for students. Employers might well give some encouragement to their trainees and apprentices to submit entries which have to be in the hands of the I.E.S. Secretary before the end of May.

There is often a certain shyness about students which prevents them putting forward their ideas, some of them perhaps feeling that the standard would be too high for them. As there has been only the one award in the last nine or ten years, and as far as we know the same number of entries, it is difficult to say what the standard is. But it cannot be so high that it is not worth a try though we can be certain that the Society will not make an award unless it is justified.

Next I.E.S. Sessional Meeting in London

The next I.E.S. sessional meeting in London will take place at the Lighting Service Bureau, 2, Savoy Hill, London, W.C.2, at 6 p.m., on Tuesday, December 11, when a paper entitled "Dark Adaptation and Miners' Nystagmus" will be presented by Dr. W. J. Wellwood Ferguson. After dealing briefly with the phenomenon of dark adaptation, the paper describes and gives the results of a number of investigations which have been carried out by the author and colleagues on miners' nystagmus, one of the contributory causes of which is said to be years of working underground in conditions of low illumination.

I.E.S. Summer Meeting

It may seem rather early to start thinking of the next I.E.S. Summer Meeting but we are all conscious of how quickly time seems to fly these days and no one is more conscious of it than an editor

or secretary, unless perhaps it is a combination of the two.

The intention of the I.E.S. to hold a meeting at Eastbourne from May 20 to 23 next year has already been announced. Additional information is now available regarding the papers to be presented.

Two of the authors will be from overseas. Mr. L. C. Kalff, of the Philips organisation at Eindhoven, will be speaking after the annual general meeting on interior lighting practice in Holland. The work of Mr. Kalff and his colleagues is well known in the lighting world and next to a visit of the I.E.S. to Holland to see what they have done in their own country a visit from Mr. Kalff to tell us all about it is the best way of us finding out. This practice of the I.E.S. of inviting speakers from overseas to attend the Summer Meetings is a very sensible one; we well remember the visits of Ward Harrison and Ivar Folcker and look forward to hearing from Mr. Kalff.

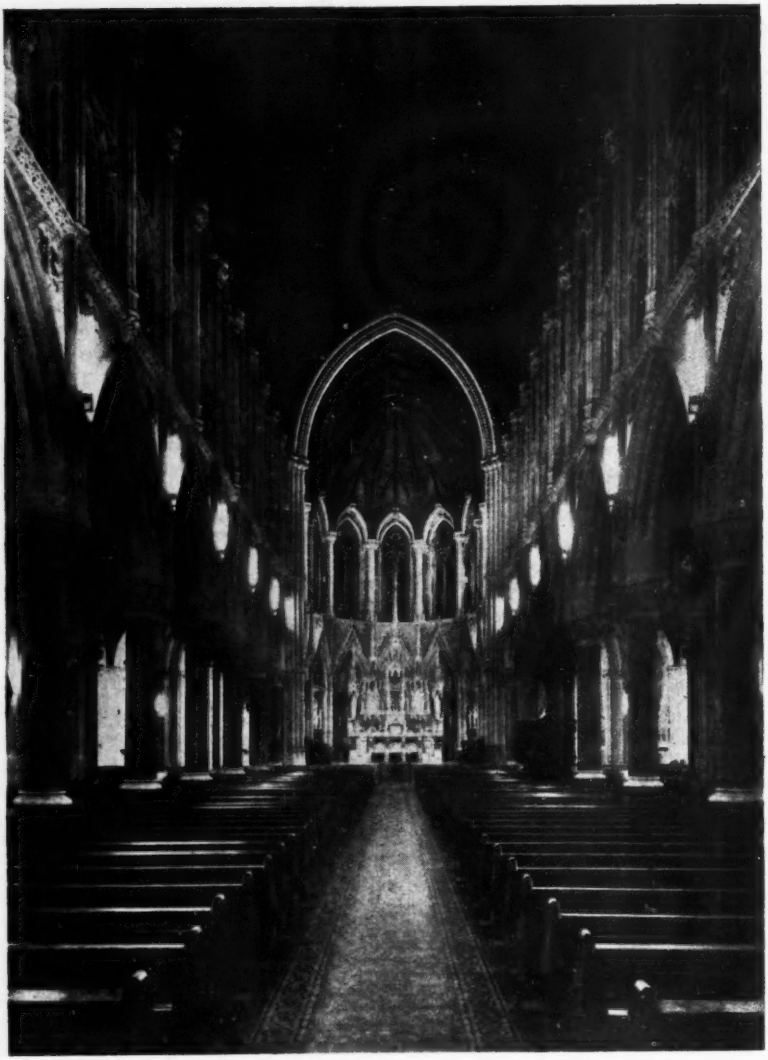
The other overseas speaker will be Mr. H. L. Logan, the director of research of the Holophane Company of New York. With the rising interest in this country in brightness engineering his visit will be most timely. We have heard something of his work through the recent papers to the I.E.S. of Robinson and Hopkinson and the Summer Meeting will be a great opportunity to hear at first hand of the work in the United States. It will be recalled that Ward Harrison at Harrogate called his address "Some Frontiers of the Lighting Art." Mr. Logan's paper will be entitled, "Two Frontiers of the Lighting Art" and will discuss criteria for artificial lighting and their use in practical design procedure, and the extension of this procedure to the design of lighting equipment and the design of lighting installations.

If a Summer Meeting needs a theme it would certainly seem that the theme of the Eastbourne meeting is to be this subject of brightness engineering as it enters into all of the next three papers. Dr. W. S. Stiles, of the N.P.L., will be giving a paper on "The Eye, Brightness and Illuminating Engineering" in which he will discuss the basic facts concerning the quantity brightness and its role in vision, the desirability of limitations on brightness or brightness ratios in the field of view and the suitability of brightness as a quantity in terms of which to couch specifications of illuminating engineering.

A paper by L. H. Hubble on "The Design of Interior Lighting Equipment" should be valuable as it discusses the complications and trends in design arising from the introduction of our present-day light sources. Though there must be a wide range of fittings to meet individual requirements there is a growing tendency to integrate lighting equipment with building structures, to meet which there are many opportunities for original thought. This paper and one by Mr. A. Pott, of the architects' department of the Ministry of Education, deserve the attention of our architect friends as well as lighting engineers. Mr. Pott, who has had a wide experience of school design, will discuss the many requirements of modern school buildings and explain the problems with which the architect is faced when considering the lighting; he will also describe some recent work and give some views on the future.

The remaining paper is by W. D. Chesterman, of the Admiralty Research Laboratory, and J. B. Collins, of the B.R.S., on "Problems of Underwater Illumination," a fascinating subject, not the everyday concern of the average lighting engineer, but one which will show us some rather unusual applications of our lamps and lighting equipment.

This programme, in our opinion, is a very constructive one. All the subjects are of the greatest importance in the lighting industry at the present time. We have been told many times that lighting design is now going through an awkward stage—at Eastbourne we have a series of papers which offer scope for the fullest discussion and we should like to see every lighting engineer (and a lot of architects) there to benefit from the meeting.



Night time view of the interior of St. Colman's ***Cathedral.***

Fluorescent Lighting in a Cathedral

Church lighting always presents an interesting problem: how to effect an efficient standard of lighting which will also enhance the existing architectural features of the edifice. This article describes the successful re-lighting of St. Colman's Cathedral.

New lighting equipment has been installed in St. Colman's Cathedral, Cobh. The previous installation consisted of tungsten lamps in glass fittings suspended in the archways between Nave and Aisles, with concealed tungsten floodlights illuminating the Altars. The illumination was uneven and of low order. There was considerable "discomfort" glare from bright units at low mounting height, and little of the structure was visible above lamp level at night. The cathedral authorities were greatly concerned, not only to improve the standard of lighting in the cathedral but to obtain an installation which would expose the full architectural detail of the interior while retaining the dignity and atmosphere proper to such an edifice. They wished at the same time to use, if at all possible, fluorescent lamps because of their economy in the use of electricity.

The illustrations show in some measure the results which have now been achieved. There is sufficient light for all purposes, with complete absence of discomfort glare for both officiating clergy and congregation; there is also dignity and aesthetic satisfaction coupled with utility. These results have been achieved by close collaboration at all stages of the work between the cathedral authorities, the consulting architect, and the staff of the Electricity Supply Board of Ireland, which designed and installed the lighting.

The installation consists of 18 units, each of one 4-ft. 40-watt flanked by two 3-ft. 30-watt fluorescent lamps in the Nave, and 14 units of similar design, each of one 2-ft. 20-watt flanked by two 18-in. 15-watt fluorescent lamps in the side Aisles. The Nave units are mounted 25 feet above floor level and the Aisle units are mounted 10 feet above floor level. The Sanctuary and High

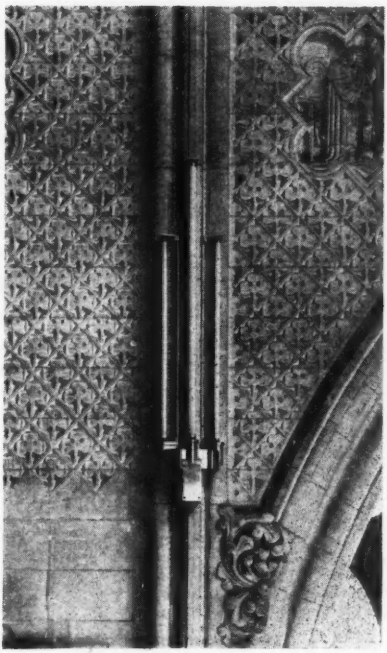


Fig. 1. Close-up view of one of the fluorescent lighting units.

Altar are lighted by 26 single 5-ft. 80-watt lamps on channel type bases, two side Altars are provided each with six similar units, and the remaining two side Altars each with four similar units. All Altar and Sanctuary units are concealed from view from the body of the cathedral. The control equipment for Altar and Sanctuary units is housed in the channel bases, but the units mounted in the Nave and side Aisles carry only their starters in their bases, and their control gear has been concealed at clerestory level and suitable points along the side Aisles. All lamps are "Natural" colour.

Lighting engineers will readily appreciate the difficulties of meeting the requirements in this case using fluorescent lamps, and may be particularly interested in the fact that perfectly satisfactory seeing conditions have been created with a relatively low level of illumination at pew level. The illumination levels are a uniform 2 lm./ft.^{2} throughout the body of the cathedral at pew level and 6 lm./ft.^{2} over the entire area of the Sanctuary and all Altars measured after the installation had been in operation for some hundreds of hours. These levels of illumination are providing visibility which is not normally achieved with illuminations under about 5 lm./ft.^{2} in the body of the building and about 10 lm./ft.^{2} in the Sanctuary. The explanation lies undoubtedly in the balance

Fig. 2. Daylight view of the interior of the Cathedralshowing how the specially designed fittings harmonise with the general architectural features.

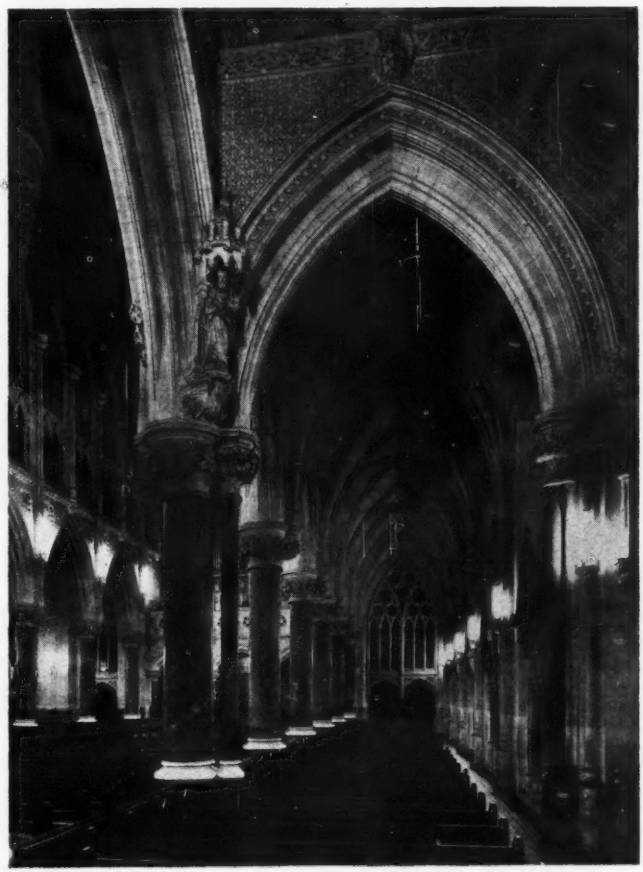
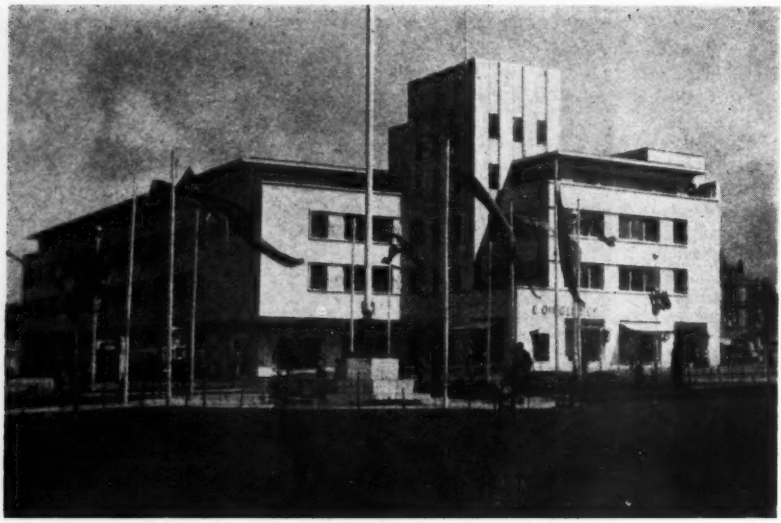


Fig. 3. Night time view of a side Aisle in the Cathedral.

of brightness in the surroundings and the complete absence of any disability or discomfort from glare. It would have been a simple matter to double the illumination by increasing the sizes of the lamps in all Nave and Aisle lighting units, but experiment indicated quite clearly that the resultant increase in the brightness of the units themselves, and the upper levels of the interior, created conditions which reduced visual acuity and destroyed many of the most attractive features of the installation as finally executed.

In daylight the Nave and side Aisle units are scarcely noticeable, while at night they convey the impression of groups of candles which provide adequate and even illumination over the whole area of the interior. Details of the architecture and embellishments are clearly distinguishable up to the highest point of the ceiling. The ceiling, which is of dark timber, makes very pleasing contrast with the white and grey stonework. There is a complete absence of any theatrical effect which might detract from the purpose of the building.

The lamps and their control gear were supplied by the General Electric Company Ltd., and the special lighting units were manufactured in Dublin by Messrs. John Smyth and Sons, Ltd., to working drawings prepared by Mr. J. R. Boyd Barrett, architect.



New Department Store in Plymouth

Most modern store lighting is concerned with the relighting of existing interiors. This new installation in Plymouth is of considerable interest, being the first post-war store to be built in this country.

The new premises of E. Dingle and Co., Ltd., at Plymouth is the first complete departmental store to be built in this country since 1939, and Messrs. Troughton and Young (Lighting) Ltd., were asked to prepare a scheme for the lighting. In collaboration with the architects, Sir John Burnet, Tait and Partners, and Messrs. Dingle, the general principles for the lighting were decided very early so that the constructional work on the building could proceed. In view of the wide area of open space on the ground and first floors, the lighting was made an integral part of the design of the building by avoiding all forms of hanging fittings, at the same time keeping the number of lighting outlets to a minimum.

Use is made on both the ground and first floors of large square fittings recessed into the ceilings suspended over the main sales areas, supplemented on the ground floor by rectangular recessed fittings adjacent to the walls and by a specially designed trough feature around the escalator areas on both the ground and first floors. To conform with the ever-increasing standards of illumination a good general intensity was planned, supplemented by high intensity spot-lamps to accentuate special displays. To give the quality of light required the main lighting was carried out with "natural"

Fig. 2. View of the ground floor escalator area showing the recessed trough lighting.

Fig. 3. View of the second floor showing similar escalator area and also showing the recessed louvred ceiling fittings.

Fig. 4. The food hall. The effect of the concealed lighting above the facias can be seen in the far end of the back wall, where it is in use compared with the right hand wall, where the lamps are extinguished.

colour fluorescent lamps supplemented with tungsten lamps. The shop-fitting equipment for display of merchandise is fitted with fluorescent lamps behind the facia boards which allows the light to go downwards on to the counter and display area and upwards to the ceiling. This upward light avoids any possibility of dark patches on the ceiling due to the fact that the main sources of light are recessed into the ceiling.

Having decided the type and form of the fittings, initial designs were prepared in collaboration with the architects, and samples made, fitted and approved on the site before full production commenced.

On the ground floor there are approximately 30 recessed fittings, 5 ft. 6 in. square, fitted at 21-ft. centres. They are made in three parts: (1) The top tray suspended on hangar bolts from the main ceiling, carrying all the control equipment and lamps. (2) The lower frame fixed around the opening, divided by a central cross-bar. (3) A louvred panel in each half of the fitting.

The louvres are made of an opaque lightweight plastic enclosed in a rigid frame. This particular plastic material has never before been used for louvres for lighting fittings, but it has the great advantage, in addition to lightness of weight, that if any of the cross-slats get damaged they can be easily replaced.

Around these square fittings were fixed thirty-six glazed trough fittings of lengths varying from 18 ft. to 28 ft. 6 in. and 12 in. wide, also recessed into the ceiling. Around the escalator is a similar type of recessed glazed trough with a total developed length of 103 ft. Both these types of fitting incorporate fluorescent lamps only. To supplement these large scale fittings, circular louvred fittings of diameters from 10 in. to 1 ft. 9½ in., fitted with tungsten lamps, are used in certain local areas.

Window lighting was carried out with fluorescent lamps over special deep louvres, and behind screens at the sides of the

Fig. 5. A close-up of one of the ceiling fittings. Note the tungsten spot lights in the four corners.

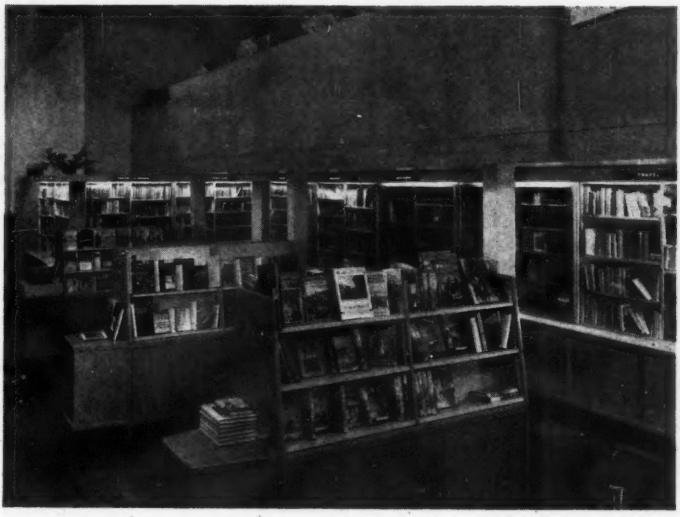


Fig. 6. The book shop. Notetheeven illumination on the book-cases.

windows with reflector spot-lamps fitted in the corners to pick out the special features of the display.

A total of sixty-one square recessed fittings of a similar type to those on the ground floor was used on the first floor. The escalator is again surrounded by a trough fitting of the same developed length of 103 ft.

The square louvred fittings contain seven 5 ft. 80-w. fluorescent lamps parallel to one another and, placed in rows between these, are a number of pearl tungsten lamps. In each corner of these fittings one 150-w. mirrored spot-lamp is fixed on an adjustable swivel. The glazed trough fittings have either a continuous row of 4-ft. and 2-ft. lamps, or continuous pairs of 4-ft., 3-ft. and 2-ft. lamps. The circular louvred fittings employ either 100-w., 200-w., or 300-w. pearl tungsten lamps according to the size of the fitting. Showcase and fitment lighting have varying sizes of fluorescent lamps.

The lighting intensities of this new store provide a degree of illumination above the normal for the stores in this country, the average illumination over the whole of the ground-floor shop being 35 lm/ft.^{2} and over the second floor, 38 lm/ft.^{2}.

In the square fittings, the switching of the lamps is so arranged that it is possible to use different types separately or all at once. Provision has also been made in these fittings for four of the tungsten lamps in every fitting to be switched separately for cleaners' use to conserve electricity outside shop hours. To provide illumination for public safety, in some of these fittings one lamp has been connected to the secondary supply.

Careful thought was given to the maintenance, cleaning and access to all fittings, especially on the large square louvred fittings. Each half of the louvred square has specially designed hinges for the easy removal of these panels for access to the lamps, wiring and control gear, and also for cleaning the louvres. On the glazed troughs, each trough had a number of separate glass panels butt joined together, which were designed to lift out for cleaning, and on the circular louvred fittings the louvres again lift out for access and cleaning.

On the second floor sales area, twin 4-ft. 40-w. fluorescent ceiling-type fittings are installed, and fittings for tungsten lamps were especially designed for the restaurant.

As may be appreciated from the above brief description, the lighting installation is one of the main features of Dingles' new store, and it is one of the most modern schemes of store lighting installed in Europe to-day.

The lighting fittings were designed and manufactured by Troughton and Young (Lighting), Ltd., and the whole electrical installation was carried out by Troughton and Young, Ltd.

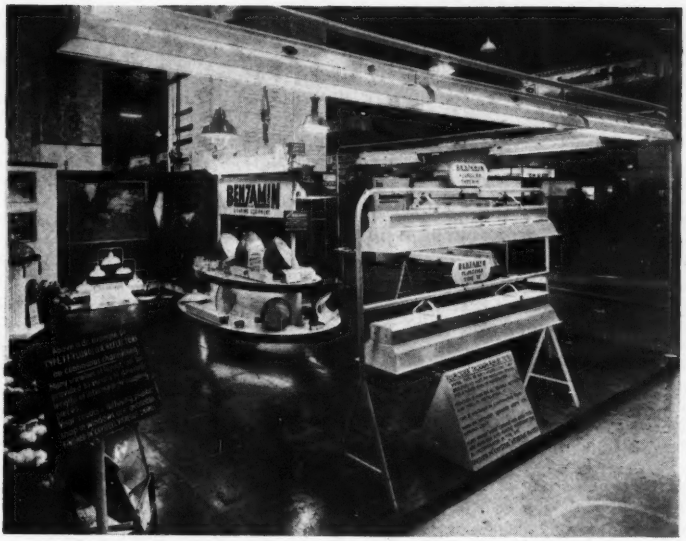
Lighting at the 1951 Motor Show

Walking round the Motor Show at Earls Court this year one could hardly help noticing what a difference the fluorescent lamp has made to this kind of exhibition. Nearly every stand was lit by means of fluorescent lamps, which were placed out of the line of sight of visitors, and in many instances positioned so that they illuminated the fascia and the exhibitor's name, at the same time giving an appreciable amount of light down on to the stand. Hence there were very few suspended fittings to be seen, and exhibits were shown to their best advantage. Good use was also made of fluorescent lamps to light the interiors of the cars and other exhibits.

The main hall at Earls Court was used entirely for the exhibition of cars, and there were no stands other than the slightly raised platforms. All the lighting was therefore from the main fixtures suspended from the roof. This part of the exhibition was very well lighted, and has been improved since the 1950 Motor Show, fittings with a higher light output having been installed for the Royal Tournament earlier this year. The lighting was formerly from four rows of seven fittings, each containing six 750-watt tungsten lamps. The two inner rows have now been replaced by two rows of six fittings, each containing 12 1,500-watt tungsten lamps. This now gives an illumination on the floor of 50 lm./ft.^{2} The lighting on the ground floor beneath the first-floor ceiling and on the first floor itself is provided by fittings containing three 750-watt tungsten lamps with or without the addition of two 500-watt mercury lamps. Owing to the comparatively low ceiling in these parts of the building and bearing in mind the variety of uses to which the building is put, it is not easy to provide good general illumination away from the centre of the hall, and much reliance has to be put on the local stand lighting.

A number of devices were used to show

The X-Ray Minx which has the appearance of an ordinary car until fluorescent lamps are switched on. The inside of the car then becomes visible.



Lighting equipment shown on the Benjamin Electric Ltd. stand.

the cars as well as possible. One attractive method was in which the car appeared to stand on a glass platform, which was lighted from beneath by fluorescent lamps, though here the lighting was more a method of attraction than a means of showing the car itself. One car was on a slowly rotating turntable, surrounded by fluorescent lamps, but though the car showed up well from a distance, close to the car one was very conscious of the glare from the lamps on the other side of the ring and of the reflected glare from the car itself. Another example of the usefulness of fluorescent lamps in exhibitions was in the lighting of the underside of a car which was tilted and lighted from one side only, the under part of the car, which was very evenly lighted without any direct or reflected glare, being viewed in a mirror.

The exhibit which attracted most attention was the "X-Ray Minx," constructed by the Rootes Group at a cost of about £15,000. The car looked like a perfectly normal, shiny black saloon car until the fluorescent lights inside were switched on, when all the "works" became visible. The double transformation took place four times every minute—five seconds solid and 10 seconds "X-Ray." To achieve this effect Pearce Signs, Ltd., devised a circuit, operated by a time switch, controlling 38 "Atlas" daylight lamps, arranged within the body of the car. The bodywork of the car was in a special black translucent "Perspex." The lamps used to give the X-ray effect were 10 18-in. 15-watt, five 2-ft. 20-watt, 11 3-ft. 30-watt, and 12 5-ft. 80-watt. The control circuit, incorporating a "leaky-field" type of reactance of special design, impresses a high-voltage surge across the lamps at each start. The lamps start and extinguish instantaneously.

Lighting exhibits included the stand of the Benjamin Electric Co., who are regular exhibitors, and Joseph Lucas, Ltd., whose model showing the effects of different types of headlamp beams was quite an attraction.

Subscriptions to I.E.S.

On page 363 of the last issue the attention of I.E.S. members was drawn to the benefits to the Illuminating Engineering Society which would result from members paying their annual subscriptions under deed of covenant. A form of deed was circulated with the last issue and I.E.S. members are reminded that in order that the Society may take advantage of deeds of covenant for 1952 deeds must be completed *before* the end of this year, i.e., before the next subscription becomes due on January 1.

The amount to be inserted on the form is the amount of the annual subscription to the Society, i.e., £2 10s., or £3 10s. in the case of Fellows.

The Building Research Congress

The recent Building Research Congress was an ambitious undertaking which, on the whole, was a success. It is evident from the amount of time devoted to it at the Congress that lighting is now being regarded by architects as a matter of some importance. The following account deals only with the lighting section of the Congress.

A congress of those interested in the various aspects of building research was held in London from September 11 to 20, under the sponsorship of the Department of Scientific and Industrial Research, with the active co-operation of the R.I.B.A., the Institution of Civil Engineers and a number of other interested bodies, among them the Illuminating Engineering Society. The president of the congress was Viscount Samuel, and the chairman of the organising committee Mr. Alister MacDonald, F.R.I.B.A., the organising secretary being Mr. K. Alsop, of the Building Research Station.

The object of the congress was to bring together for the discussion of problems of common interest all those, both in this country and abroad, who were concerned with the impact of present-day research on the design and construction of buildings. The number attending exceeded 1,000, of whom over 250 were from some 50 countries overseas. Papers were invited from prominent workers in the field of building research and these were available, shortly before the congress opened, in three substantial volumes.

In order to cover conveniently the very wide range of subjects to be discussed, the technical work of the congress was planned in three divisions, dealing respectively with (a) the engineering and structural aspects of building, (b) building materials, and (c) the various factors which influence the comfort and efficiency of the occupants of buildings, divided broadly under the three heads of lighting, acoustics, and heating and ventilation. The total number of papers read and discussed was 90 so that it was necessary for the various divisions to meet in parallel and, in fact, in order to leave as many afternoons as possible free for technical visits and other activities, there were frequently five sessions in progress at one time, the average number of papers presented at any one session being three. The lighting sessions (Division 3, Part III) were all held in the lecture theatre of the Royal Institution of Chartered Surveyors.

Brightness and Glare

The first of these sessions was held on Wednesday morning, September 12, under the chairmanship of Mr. R. O. Ackerley. It was concerned with the subjects of brightness and glare and necessary values of illumination. The first paper, by Dr. Ward Harrison and Mr. Phelps Meaker, of the United States, was presented, in the absence of the authors, by Dr. Walsh.

It was a general account of present-day developments on the other side of the Atlantic, somewhat on the lines of Dr. Ward Harrison's article in *Light and Lighting* for December of last year, but with a long introductory section on lighting principles. This proved very valuable in enabling an audience mainly inexpert in lighting matters to appreciate the basis on which modern developments are founded and the different factors in a lighting system which have to be taken into account when attempting any assessment of the degree of comfort achieved.

The Glare Factor system was described, and particular reference was made to the use of unshielded fluorescent lamps. Even fluorescent fittings, the author said, should be arranged for endwise viewing by the majority of occupants if the luminance of

the side panels was in excess of about 150 foot-lamberts.

The second paper, by Dr. R. G. Hopkinson, described the results of the extensive researches which have been carried out over the last few years at the Building Research Station. The "multiple criterion" technique of appraisal of comfort conditions was explained and the results of its application to the study of various sets of conditions were described; in particular the advantages of a "contrast grading" of sources of high brightness and the effects of grading the contrast between the working area and its immediate surroundings were dealt with in some detail. Much of the work described by Dr. Hopkinson has been published either in comparatively recent issues of the Transactions of the Illuminating Engineering Society or, in more general terms, in *Light and Lighting* for January of this year.

Illumination Values

In view of the emphasis now being placed on "brightness engineering" it was interesting to find that in his concluding paragraphs Dr. Hopkinson wrote, "Lighting the working plane will always remain the main task of the lighting engineer," though he added immediately, "but the importance of the scientific lighting of the surroundings must soon be more generally accepted." That there should be a proper balance between these two phases of lighting design was well worth mention and it was all the more appropriate because the next paper to be read, that by Mr. H. C. Weston, dealt with the values of illumination required in artificial lighting for various tasks. After an interesting account of the historical development of quantitative illuminating engineering, Mr. Weston described some of the work that had been done to show how productivity was related to the values of illumination provided and he then briefly sketched the arguments and his own research underlying the present I.E.S. Code. These are sufficiently familiar to readers of *Light and Lighting* to make further reference here unnecesary but, to many in the audience, the fact that there could be a rational and scientific, as distinct from a purely empirical, basis for such a Code no doubt came as a pleasant surprise.

Schools and Factories

At the meeting on the morning of Thursday, September 13, the chair was taken by Mr. W. A. Rutter, chief architect of the Ministry of Works. This meeting was described in the programme as "A symposium to review the effect of work on brightness and glare on the design of classrooms and factories," and the first paper was one dealing with American experiments on school lighting. It was presented by Mr. W. Allen in the absence of the author, Prof. R. L. Biesele, Jr., who has done a great deal of work on this subject at the Southern Methodist University in Texas. Perhaps not unnaturally, much more of the paper was devoted to daylight than to artificial lighting and an interesting scheme was described in which the full length of the left-hand wall in a classroom was occupied by light-directing glass block panels from a height of 6 ft. above floor level, a clear-vision strip being provided below the glass blocks to provide a view of the scene outside. An extensive programme of research under Prof. Biesele's direction is in progress in a special experimental building in which the different variables can be separated to some extent so that their effects on the lighting inside a large-scale model classroom can be investigated. It is interesting to notice the high regard in which the venetian blind is held in the United States. Prof. Biesele wrote: "Our studies have indicated that the interior venetian blind is probably the most satisfactory daylight control device available commercially." On the subject of artificial lighting Prof. Biesele referred his audience to the American Standard Practice for School Lighting, issued in 1948, from which he reproduced two tables giving respectively recommendations for the limiting brightness ratios in a schoolroom and for values of illumination at the work.

The second paper at this session was a general one on factory lighting by Mr. W. Allen and Mr. J. B. Collins, who made several challenging statements. On daylight design they stated that "the north light, despite its long popularity, can be said now to be inappropriate for most kinds of work" and they tended to favour the "monitor" form of roof, although they said that the ratio of the high to the low bays was often wrong, with consequent great unevenness of the illumination at the working plane. Concerning artificial lighting they said: "Numerous visits to factories have left us the firm impression that in the production areas, the fittings used have been designed primarily to get the maximum light from the fitting on to the working plane and that visual comfort has received little consideration. . . . The chief faults are that the fittings are too bright at common viewing angles, and are seen against ceilings which are too dark. . . . The existing

regulations and recommendations leave the sources still easily seen and the brightness limit is far too high." The authors then went on to advocate the grading of brightness, so that between the brightest parts of a fitting and the comparatively dark ceiling there should be a surface of intermediate brightness.

Turning to the quality (as distinct from amount) of the illumination on the working plane Messrs. Allen and Collins described an interesting example of the use, in a weaving shed, of a mixture of general lighting by fluorescent lamps and directional lighting by filament lamps. They concluded with a section on the appraisal of good lighting in which they wrote: "The subjective impression created by the whole lighting installation, including the decoration, is a more important factor in its success than is the actual level of illumination on the working plane."

Daylight Research in Australia

A paper which had a special interest as showing the difference of approach to problems of daylight which is necessary in different parts of the world was contributed by Dr. A. Dresler and Mr. A. L. Brentwood, of the Department of Labour and National Service of Australia. The authors first pointed out that for the Australian architect daylighting was a very important aspect of industrial building design because in that country a number of factors, including the normal span of working hours, the good atmospheric conditions, the high cost of electricity and the availability of space for single-storey factories, combined to make it possible for many factories to dispense almost entirely with the use of artificial lighting. Further, the climatic conditions were such that it was most important to provide natural ventilation and to have means for controlling the entry of direct sunlight into workrooms. An extended programme of research, they said, was being carried out and recommendations were made from time to time. In a bulletin entitled "The Natural Lighting of Industrial Buildings," issued in 1948, the daylight factor recommended for rough work was 1 to 2 per cent., for medium work 2 to 4 per cent. and for fine work 4 to 8 per cent., with still higher values in the case of extra fine work. "Many Australian buildings," the authors added, "have been erected to these standards and have not been regarded as unduly costly."

A problem which has evidently been worrying the research workers, both in Australia and elsewhere, is the fact that neither the daylight factor as at present defined nor the sky factor are entirely satisfactory as criteria of the daylight conditions at a point in a room. The daylight factor is not very good for specification purposes because it is liable to quite considerable variations according to the meteorological conditions. The sky factor, being calculable from given dimensions, is invariable, but it does not include reflected light which sometimes forms an important part of the total light reaching any point. A suggestion was made in the paper for a modified form of daylight factor designed to reduce the variations to which the present daylight factor is subject.

The control of sunlight penetration is being actively studied by the department to which the authors of this paper belong and already a number of devices have been produced to assist the architect to assess the extent of the penetration of sunlight through unscreened windows facing particular aspects, the practicability of effective screening and the most suitable type and size of "sunbreaks" for the purpose. These aids include "sun position diagrams" and, for use in combination with them, "sunbreak protractors" which show immediately over what periods complete screening is obtained with particular sunbreaks or, conversely, what size of sunbreaks must be used to give full screening at certain times. Examples of these aids were shown by the authors and they explained how a further step had been taken by preparing in advance, for certain important localities, so-called "screening assessments." These are, in fact, data sheets giving, for any particular aspect, (a) the times of sunlight penetration through unscreened windows, (b) the times of maximum direct glare, (c) a comparison of the main screening methods, (d) performance data on the type of fixed sunbreaks most suitable for the aspect, and (e) some typical shadow-angles for times of partial screening.

One of the illustrations to this paper showed a particularly interesting form of window consisting of adjustable sunbreaks opening either horizontally or vertically, in the upper part of the window wall, the lower part being occupied by a "vision strip" of clear glass to provide a view. It was pointed out that because the opening of both windows and roof-lights was needed for ventilation and to secure adequate air-movement in a building, the design of the

fenestration could not be treated as a matter governed by daylighting considerations alone. The authors concluded a most interesting and stimulating paper by mentioning a number of problems which, in their opinion, called for further study. Among these was the usefulness of diffusing, heat-absorbing glass in large areas on the sunny side of a building.

During the general discussion which followed the presentation of these papers, Mr. G. Pleijel described a special form of roof construction adopted in some factories in Sweden, and Professor Reichenberg showed on the screen a calculating diagram which he used for determining the extent of the sunlight penetration in a given building layout.

At a certain stage in the discussion the chairman asked those of the delegates present who were architects to hold up their hands, and it was very interesting to note that of the audience of 60 or more in the hall, some two-thirds belonged to the architectural profession.

Daylight Records

The session on the next day (Friday, Sept. 14) was held under the chairmanship of Mr. W. J. Jones. There were four papers dealing with the subject of daylight from different points of view. The first, by L. H. McDermott and G. W. Gordon-Smith, of the National Physical Laboratory, was purely factual, and gave the results of a continuous registration of daylight values at Teddington, extending over a period of some five years. The records were obtained by means of a photocell and auxiliary apparatus which gave a continuous record of the daylight in one or other of the four octants of unobstructed sky facing one of the cardinal points of the compass. Direct sunlight was excluded, so that the records referred to skylight only. The apparatus used by the authors was described, and they explained how the records obtained were analysed so as to provide the material for the five tables in which the results were presented. There was one table for each octant, and one for the whole sky, and each table gave the average illumination prevailing at any hour throughout the day for each month of the year.

Readers will be familiar with the daylight diagram in the I.E.S. Code (page 4), from which it is possible to read off, for any time of the year, the period of the day during which, on the average, the illumination may be expected to exceed 500 lumens per square ft. From the tables given by Messrs. McDermott and Gordon-Smith it is possible to prepare a similar diagram for any other value of illumination; and, in fact, their paper contained such diagrams for 500, 250, and 100 lm/ft.[2]

Daylight Factor and Sky Factor

The second paper, by Mr. P. Petherbridge, of the Building Research Station, was entitled "The Computation and Measurement of Sky and Daylight Factors," and the first part of it contained a description of these two factors and of the familiar methods of computing or of measuring them. The author then pointed out the difficulty that, because even the most uniform of skies differed considerably in brightness from horizon to zenith, the daylight factor at any point was far from being a constant and depended on the particular patch of sky which contributed most to the illumination at the point. For instance, it had been found that on overcast days the brightness was much higher at the zenith than near the horizon, whereas on a cloudless day the horizon brightness was the greater. In general, if measurements were made only on densely overcast days, the results obtained in a survey of daylight factors would be reasonably reproducible.

The author then went on to describe the methods used at the Building Research Station, where the sky brightness was measured at an elevation of about 45 deg., generally through an open window, using a Schuil telephotometer or other similar instrument, the internal illumination at the point under consideration being measured immediately afterwards with the same instrument. In conclusion, Mr. Petherbridge suggested a modified form of daylight factor, to be called the "daylight brightness factor," and defined as the ratio of the internal illumination to the brightness of that area of the sky seen from the indoor position.

Daylight Research in Sweden

Mr. Petherbridge's paper was followed by one read by Mr. Gunnar Pleijel, of the Royal University of Technology, at Stockholm, a very familiar personality to all delegates to the recent C.I.E. meetings and an indefatigable photographer. Mr. Pleijel has carried out a long series of experiments on daylight, using models under an artificial sky. A full account of this work was recently published in Sweden, and a brief review appeared in *Light and Lighting* for March, 1950. The investigation was mainly concerned with the light distribution in rooms facing the insides

of hollow square blocks of flats with walls of different reflection factors. In the paper presented at the Congress, Mr. Pleijel described a method which he had devised for computing daylight factors and he compared the results so obtained (as well as those obtained by another method, due to Hannauer) with the results given by the model studies. The agreement was found to be quite reasonable. On the use of models, the author said that the method was very useful, provided it was used with intelligence. His faith in it has led to the construction at the University of a new artificial sky (reminiscent of the roof of the Dome of Discovery at the South Bank Exhibition) over 20 feet in diameter and illuminated from below by 16, 200-watt lamps so arranged and screened that the illumination of the underside of the dome does not differ from the average value of 500 lux by more than about 2 per cent.

The fourth paper at this session was by Messrs. W. A. Allen and J. B. Bickerdike, of the Building Research Station, who discussed the influence which daylighting research might be expected to exert on the design and layout of buildings. As the authors pointed out, methods of predicting daylight in a proposed building are of much more interest to designers than methods of measuring the daylight conditions in an existing building. Unfortunately, however, the predetermination of sky factor values has, as mentioned by the authors of earlier papers, the great disadvantage that it omits the contribution of reflected light to the total illumination at a point, and this contribution may, in certain cases, be of vital importance. Nevertheless, sky factor studies have been of great assistance in such problems as the design of school classrooms and of factories, especially when these are largely lighted from the roof. The authors pointed out that in cases where sky-factor calculations might be seriously misleading, model studies could be of great assistance.

In the second part of their paper, Allen and Bickerdike mentioned the work which had been done on the grading of brightness contrasts and showed how the results of this work were just as important to the designer of the fenestration of a building as to those concerned with artificial lighting schemes.

The discussion at this meeting was very lively and interesting. Mr. Pleijel, referring to a question addressed to Messrs. McDermott and Gordon-Smith as to the availability of daylight records for localities other than Teddington, mentioned that such records, covering a period of some years, had been obtained by Prof. Lunelund in Finland. He also discussed the difficulties attending the use of the daylight factor and sky factor as at present defined. Years ago he had advocated dividing the daylight factor into two parts, one referring only to light received directly from the window and termed the "direct daylight factor" while the other, termed the "reflected daylight factor," included only light reflected from surfaces inside the room. Both Mr. Pleijel and a delegate from Holland exhibited mirror apparatus by means of which it was possible to determine very quickly and easily the sky factor at any point in an existing building. Mr. Beckett referred to Townend's mechanical integrator which gave values of sky factor directly, and Mr. Bowen, of I.C.I., said that special diagrams were in preparation to facilitate the calculation of the sky factor given by a roof containing a number of windows distributed regularly over its surface.

Colour

The final session of this section of the Congress took place on Monday morning, September 17, under the chairmanship of Dr. Walsh, who was the representative of the Illuminating Engineering Society on the Organising Committee of the Congress.

Two papers on colour in the lighting of buildings were presented. The first, entitled "The Functional Use of Colour," was by Mr. Faber Birren, who has done a great deal of work in the United States on the use of colour, especially in factories, schools and hospitals. In Mr. Birren's absence this paper was presented by Mr. R. Wilson, Director of the British Colour Council. Mr. Birren claimed that the merits of a good colour scheme could be demonstrated objectively and that a scheme which had been found in this way to be satisfactory always looked well. "Functional colour," he said, "is not in the least interested in personal opinions about colour or artistic notions as to its emotional appeal. Quite the contrary, the best of scientific practice requires that colour be applied to make seeing easier, to smooth out unfavourable contrasts, minimise constant eye adjustments, draw attention to tasks and hazards—objectives which, fortunately, may follow technical method and be accurately measured in their effectiveness."

After this somewhat challenging statement the author went on to discuss the various effects of high illumination values, brightness distribution, and colour in producing good seeing conditions and reducing fatigue, but his lines of argument were by no means easy to follow. His conclusions were,

however, fairly simple. They may be summarised as follows: (a) Bright light and pale colours stimulate physical activity and promote cheerfulness; (b) bright light and soft (not deep) colours are appropriate for offices and schoolrooms; (c) for very fine and exacting tasks, moderate illumination and soft colours should be used for the room in general, with as much extra local illumination as necessary on the area of concentration.

Mr. Birren reported an interesting attempt made in America in 1947 to obtain the opinions of businesses which had used colour schemes. Not unexpectedly, "many companies were unprepared to evaluate their programmes, primarily because of the difficulty involved in measuring the effects of a service as intangible as colour," but an overall summary showed that 75 per cent. were pleased or satisfied, 6 per cent. were dissatisfied, while 19 per cent. had no opinion one way or the other.

On the basis of an investigation in a United States Government office the author concluded that "right illumination and right colour are worth about $139.25 annually per average employee in American industry to-day." It will be obvious that a number of assumptions had to be made in arriving at this conclusion.

In the final part of his paper Mr. Birren referred to a colour code for safety which, he claimed, had greatly reduced the accident rates in certain cases where it had been employed; again he made a striking calculation of the financial benefits obtained.

Mr. H. L. Gloag, of the Building Research Station, who presented the second paper, "The Development of the Use of Colour in British Factories," was much more factual in his remarks. He gave it as his opinion that progress in the use of colour in factories was hampered in this country by a shortage of consultants and the lack of an understood basis for colour treatment. He went on to discuss the various factors which limited the choice of colours in any particular case. Just as it had been found advantageous to grade the brightness contrasts from the object of attention to the surrounding areas of the field of view so it seemed reasonable to assume that in the immediate vicinity of the point of work the colour should be the same, or nearly the same, as that of the material being processed. The use of light colours to promote cleanliness, particularly in such factories as those manufacturing foodstuffs, was mentioned. Another well-established use for colour was to help in correcting an adverse indoor climate by the employment of "warm" or "cool" colours as appropriate.

This session was very well attended and a lively discussion followed the reading of the papers. Mr. Dutton mentioned examples of difficulties which had been encountered when designing a colour scheme for a large chocolate factory, owing to the conflicting requirements of different interests; Mr. Wood, of I.C.I., declared himself opposed to a colour code for safety, while Mr. Hartland Thomas, an architect, said that the great need was for a series of rules which would act as a guide to the designer of colour schemes.

The authors' replies to the discussion were followed by a general review by the chairman, described in the programme as "a paper bringing together the outstanding points in the contributed papers and indicating future trends."

Dr. Walsh said that both brightness engineering and the use of colour were subjects somewhat new in the lighting field. The useful work already done was an indication that these subjects were well worth pursuing. He pointed out that the "glare factor" was not a measure of the amount of glare present; all it could do was to put systems in order of merit as far as their glare effects were concerned. Any rules resulting from a simplification of what was, in reality, a very complex problem should be regarded with caution. On the subject of colour he pointed out that nothing had been said as regards the use of coloured light. This could now be produced economically and its application in lighting might repay investigation. Meanwhile, he drew attention to the effect of the colour of the illuminant on schemes of colour decoration.

The difficulties attending the use of either daylight factor or sky factor as a criterion of performance in daylighting were raised in more than one paper, and Dr. Walsh suggested that a solution might be sought along the lines of dividing the total daylight factor into two parts, one, the direct light expressed as a fraction of the luminance of the effective patch of sky, the other, the reflected light expressed as a fraction of the illumination from the whole sky. On the application of the results of daylight research in building design, Dr. Walsh said that there was clearly need for some more effective means of bringing to the notice of such people as factory owners and factory workers—who were, in fact, the ultimate beneficiaries—the improvements in comfort and efficiency that could be secured by using up-to-date

methods of securing good daylight conditions.

This was the last technical session on lighting, although other sections with longer programmes continued their meetings on the two following days. On Thursday, September 20, there was a combined session of the whole Congress held in the Royal Festival Hall. At this a number of overseas members gave their impressions of the work accomplished at the Congress.

It was the universal opinion that the meetings had been most valuable to all who had attended them, and several speakers mentioned the additional benefit of the personal contacts made between meetings. The lighting sessions certainly led to exchanges of views between illuminating engineers and architects on a scale which must have been most valuable to both professions.

At the closing session a speaker from Australia dropped a bombshell when he announced that, as part of its economy programme, the Australian Government had decided to close down all building research. In view of the evidence in several papers that Australia is making a very considerable contribution to building research (including daylight research) this seems most regrettable, and several subsequent speakers expressed their hope that wiser counsels would prevail.

The Congress closed with an address from Sir Ben Lockspeiser (secretary of the D.S.I.R.), and with the usual vote of thanks.

The Social Side

Apart from the main social functions, which included a Government reception at Lancaster House and a visit to the Palace of Westminster, receptions for overseas delegates by the London Master Builders' Association and by the L.C.C., a dinner and dance at the Connaught Rooms, when the guest of honour was the ex-Minister of Works (Mr. Brown), and a concert at the Royal Festival Hall, there were a large number of technical visits and excursions available to delegates. Naturally many of these were of primary interest to those concerned with structural design and materials, but those chiefly interested in lighting participated in the visits to the Building Research Station and to the National Physical Laboratory. At the Luton works of Vauxhall Motors, Ltd., too, particular features were the very large installation of fluorescent lighting and the use of colour schemes to provide good working conditions. There were also visits to a number of recently constructed schools in Essex, Hertfordshire and Middlesex. Most of these had been designed to provide a high daylight factor in the classroom, and in several of them colour schemes had been introduced. Special excursions were arranged for the ladies.

All those concerned with the detailed organisation of the Congress are to be congratulated on the smoothness with which the arrangements were carried out. In particular, Mr. K. Alsop and the excursions secretary, Mr. J. Crisp, deserve a special word of praise for their unobtrusive efficiency. The W.V.S., too, were of great assistance, acting as "universal aunts" to all the delegates.

Publication

There is no doubt that the value of the meetings was greatly enhanced by the fact that the papers, beautifully produced in three volumes, were in the hands of all the delegates some time before the Congress. This enabled each delegate to read beforehand those papers in which he was most interested, and a brief presentation by the author was therefore all that was needed.

It is understood that summarised accounts of all the discussions are to be published in a format similar to that of the three volumes of papers. Inquiries should be addressed to the Organising Secretary, the Building Research Congress, 1951, at 57, Onslow-gardens, South Kensington, S.W.7.

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Steel Company of Wales

The new steel works in South Wales are some of the largest industrial premises erected in this country since the war. The lighting includes a wide variety of applications and was the subject of special attention by the consulting engineer and others concerned. This article deals only with the Abbey Works.

Internal Lighting

The lighting in the new Abbey Works represents a load of approximately 6,000 kw. and has been installed by Holliday, Hall and Stinson, Ltd., Drake and Gorham, Ltd., W. J. Furse, Ltd., and J. W. and E. Morris, Ltd., under the direction of the consulting engineers, Messrs. McLellan and Partners.

Although the minimum intensity laid down in the Factories (Standards of Lighting) Regulations, 1941, does not apply to melting shops or rolling mills, it has been found desirable to maintain a minimum intensity of 6 lm/ft.² in a modern works to reduce the risk of accident and allow maintenance and repair work to proceed without auxiliary lighting. The speed of the product, which varies from 900 to 2,500 ft. per minute in a continuous rolling mill, also requires an intensity higher than that considered economical in many steelworks.

The minimum intensities in the principal areas are as follows:—

LIGHTING INTENSITIES RECOMMENDED FOR STEELWORKS BUILDINGS

	lm/ft.²
Stairs, gangways, lavatories	3
Slab yards Melting Shop Raw Materials Bay Ingot Stripping Soaking Pits	6
Boiler House (General) Pump Houses Stores Blast-furnace Working Areas Pickling and Cleaning Lines	6
Mould Preparation Rolling Mills Boiler House Firing Floor Power and Blower House Control Rooms and Substations Offices: Executives, foremen, clerks	12
Laboratories Offices: Accounts, calculating M/Cs., typing Slab inspection and conditioning Cold Strip Mills Sheet and Plate finishing Tinning Machine and Roll Shops	20
Drawing Office	30
Tinplate Inspection	50

To simplify the regular cleaning necessary to maintain these intensities economically without relying on the use of the cranes, walkways have been constructed on the main roof trusses, and the lighting fittings attached to brackets cantilevered off the walkways. Elsewhere detachable-type fittings have been

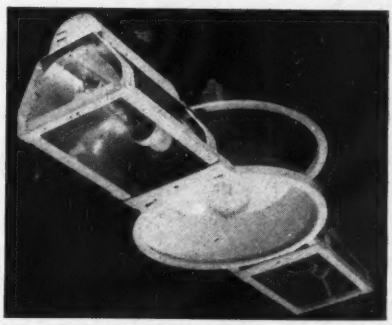


Fig. 1. B.T.H. blended fitting incorporating one 1,000-w. tungsten and two 400-w. mercury vapour lamps.

WEATHERING TESTS ON ANODIZED ALUMINIUM

Specimen No.	Position in Works	Condition after Exposure	Reflectivity per cent.*		
			(*a*)	(*b*)	(*c*)
1	Top of gas-holder	Dirty, no pitting	64	73	74
2	Over soaking pits	Dirty, no pitting	62	71	73
3	Over cogging mill	Dirty, no pitting	59	70	73
4	Office	Little dirt, no pitting	67	73	74
5	Pig casting (pouring)	Dirty, severe pitting	46	54	72
7	No. 1 blast-furnace platform	Dirty, slight pitting	48	60	71
8	No. 1 blast-furnace distributor	Dirty, severe pitting	33	34	73
9	Pig casting (strands)	Dirty, severe pitting	38	50	71
10	Melting Shop, over furnace	Dirty, no pitting	62	68	69
11	Coke ovens (quenching)	Dirty, slight pitting	50	65	70
12	Over coke ovens	Very dirty, moderate pitting	12	28	67

* Original reflectivity approximately 75 per cent.

(*a*) Reflectivity in dirty condition after 4 months' exposure.

(*b*) Reflectivity after washing with soap and warm water.

(*c*) Reflectivity after washing and cleaning with "Luminisor."

specified so that they can be changed for clean units and the dirty ones returned to the maintenance shop for reconditioning.

The bays in the main buildings are about 100 ft. wide with roof trusses spaced at 40 ft. intervals; this gives a general mounting height of 45 ft. The intensity is varied by the number of fittings per truss, two, three or four fittings are provided for intensities of 6/8, 12/15 and 16/20 lm./ft.^{2} respectively. Each fitting or group of fittings houses two 400-watt mercury discharge lamps and one

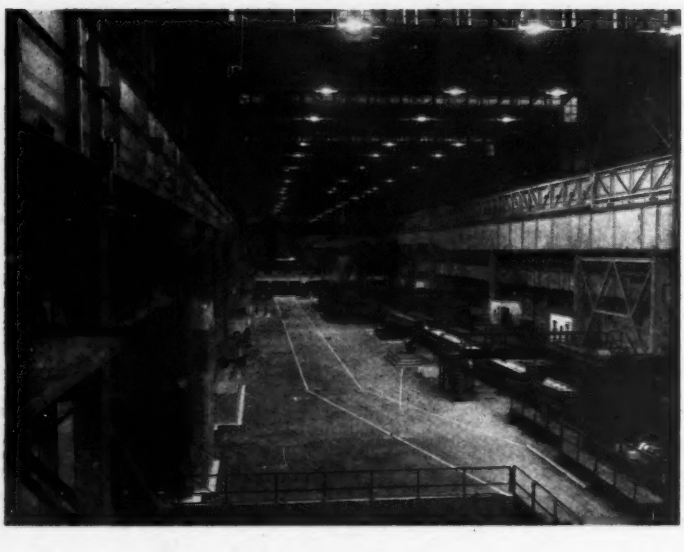


Fig. 2. Showing the installation of B.T.H. blended lighting units in the rolling mills.

Fig. 3. Another view of the rolling mills.

1,000- or 1,500-watt general service tungsten lamp. The decision to incorporate a tungsten lamp was largely influenced by the fact that a steelworks electrical system is subject to surges of sufficient duration and amplitude to extinguish mercury discharge lamps and, although in a well-designed installation these surges are infrequent, the possibility of a complete blackout must be avoided. Secondary advantages are the improved colour quality of the light and the avoidance of stroboscopic effects, which are not always completely eliminated by connecting adjacent fittings to different phases.

Special fittings to the consulting engineers' specification were constructed by the B.T.H. Co. for the main mill buildings. These comprise a standard vitreous enamelled reflector for the tungsten lamp and two easily detachable aluminium reflectors for the mercury lamps, mounted in an aluminium frame. The mercury lamps are mounted horizontally, with magnetic arc control, this arrangement having proved more efficient during fields tests on existing mills. In a test of 500 hours' duration the light from a vertical lamp dropped 40 per cent., whereas that from a horizontal unit dropped only 28 per cent. Tests were also carried out with anodised aluminium specimens to check the effect of steelworks atmospheres on the reflectivity. The result of these tests is given in the table. Over 1,000 of these

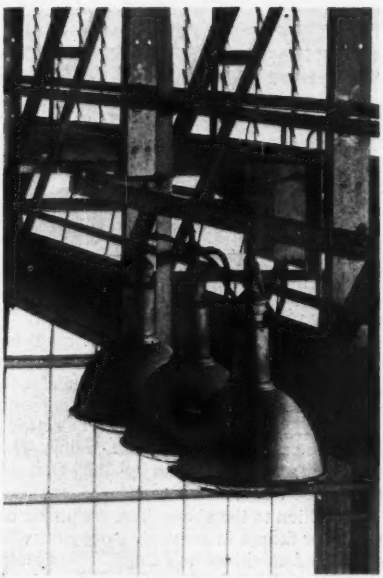


Fig. 4. Benjamin high bay units used in the soaking pits and stripper building.

Fig. 5. View of the stripper building and soaking pits.

special fittings which are now known as the Mazda T.891 have been installed in the works.

Conditions in the melting shop and soaking pits are too severe for open-type fittings and standard Benjamin High Bay Units have been installed in groups of three to give the same colour blend as in the mills. Over 200 groups of these fittings have been installed. They are suspended from steelwork attached to the walkways.

The two motor rooms are air conditioned and Holophane Brabazon-type fittings were specified as illumination was required above the horizontal plane of the fittings. Seventy-eight groups of 1,000-watt tungsten and 400-watt mercury lamps have been installed.

Bare cold cathode tubes have been installed in the two main control rooms to give a pleasant and well-diffused light with freedom from flickering or blackout during surges. The transformers and electrode boxes are concealed in the false ceiling. The equipment was supplied by the General Electric Co., Ltd.

In addition to the above there are hundreds of smaller fittings in basements, departmental offices and auxiliary buildings. Benjamin heavy-duty "Saaflux"-type reflectors and Dorman Diolux fittings have been installed for general lighting in the works and tubular

Fig. 6. The railway sidings showing the 150-ft. towers.

fluorescent lamps in fittings by G.E.C., Revo and Ekco-Ensign in the offices.

External Lighting

The long and comparatively narrow sidings are illuminated by narrow angle projectors mounted on 150-ft.-high self-supporting towers. The towers were designed by W. S. Atkins and Partners and constructed by Messrs. Braithwaites. They have a 10-ft. square platform at the top and an internal access ladder arranged in 30-ft. sections with small intermediate platforms. Each tower covers an area of about 500-ft. radius, the number of projectors (up to 24) on each tower being varied to give a good working illumination according to requirements in the area.

The G.E.C. projectors are fitted with hoods, focusing screens, and training sights, and preset devices to ensure that the unit is returned to its correct orientation after cleaning. They are equipped with mirrored glass reflectors and 1,000-watt Class B.1 projector lamps to give a 12-degree beam angle. The present layout requires 125 projectors. The installation has proved satisfactory in avoiding obstruction from numerous low poles, in minimising dark shadows with elimination of glare.

Smaller areas are lit by Simplex "Reflecta" floods and 200-watt G.E.C. units mounted on low towers or buildings. The main approach road is lit by 250-watt mercury discharge lamps in G.E.C. "Difractor" side entry lanterns mounted on Concrete Utilities columns. The works roads are being illuminated by G.E.C. Oxford and Wembley lanterns on "Adastra" steel columns.

Switching

The lighting in the larger buildings is controlled by contactors mounted directly under the final sub-circuit fuseboards; each contactor controls four 40-ft. bays and is operated by push-buttons at floor level. Where the intensity is greater than 12 lm./ft.^{2} the contactors are arranged so that half the intensity can be maintained when the full intensity is not required.

The control system is laid out so that photo-cell control can be added, should this be found desirable. The photo-cells would be mounted inside the buildings to respond to the daylight intensity as affected by dirty windows or atmospheric pollution.

All external lighting units are switched by a direct current impulse injected into the medium voltage network. The impulse operates relays which control small loads direct or larger loads through contactors. The system of control ensures that external

Fig. 7. View of the railway sidings at night.

lights are not left burning during daylight and has the further advantage that isolated lamps can be connected to the nearest circuit and still be controlled as external lighting.

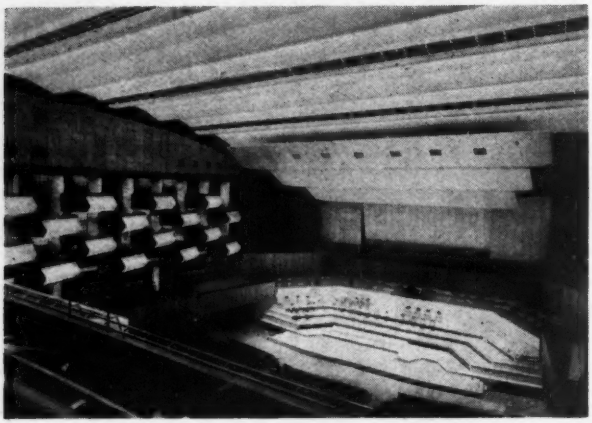
Wiring System

The general lighting is supplied from the 415-volt three-phase four-wire supply by separate distributors from the main distribution points, duplicate supplies are available for the larger buildings. Although 240 volts is used for all "fixed" lighting it is not considered safe for portable equipment and this is therefore fed from double-wound transformers having a 110-volt secondary winding with the centre point earthed. This reduces the shock risk to 55 volts and has the advantage that portable electric tools can be connected to the lighting sockets which are rated at 15 amperes. Portable lighting equipment is fitted with special plugs equipped with double pole fuses rated to protect the flexible cable. Portable lamps used for the internal inspection of boilers, condensers and similar plant, where the presence of moisture increases the risk, are supplied at 25 volts from local transformer socket units.

All sub main and circuit wiring is carried out with mineral insulated copper covered cable and forms the largest earth concentric system in the country. By using the copper sheath for the neutral conductor both the weight of copper and the volt drop in the circuit is reduced.

The chokes for the main bay lighting fittings are enclosed in aluminium boxes equipped with an isolating switch and connector blocks for incoming cables and flexible leads to the fittings. These were supplied by the B.T.H. Co. and are fitted under the handrails of the walkways. Johnson and Phillips capacitors are connected to the main lighting distribution boards to raise the power factor to .9 lag at full load.

Acknowledgment is made to Messrs. McLellan and Partners for having prepared this article and to the Steel Company of Wales, Ltd., for permission to publish it. Acknowledgments for photographs used are made to the following firms: The British Thomson-Houston Co., Ltd., The Benjamin Electric, Ltd., and The General Electric Co., Ltd.



ROYAL FESTIVAL HALL LONDON

Platform lighting for concerts and ballet together with remote control dimming for entire hall.

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Medical Aspects of Light

The following is a report on the conference of the Comité International de la Lumière held in Paris during September. The conference was attended mainly by members of the medical profession, and one of the purposes of the meeting was to distinguish between the activities of this committee and those of the C.I.E.

There are often distinct differences, as E. C. Bentley has pointed out in the prototype Clerihew, between scientific endeavours with similar names. Geography, he tells us, is about chaps, whereas biography is about maps, or perhaps it was the other way round. A distinction, perhaps not equally clear, exists between the International Commission on Illumination (C.I.E.) and the International Committee on Light (C.I.L.).

The Comité International de la Lumière was founded in the late twenties primarily with the object of gathering together people who are interested in problems of photobiology and particularly in the germicidal and therapeutical properties of ultra-violet and infra-red radiation. Most of the original members were either medical people or biologists. Several international conferences were held before the war. The war, however, took its inevitable toll of the membership. The surviving members of the organising body were therefore faced with the problem as to whether there was sufficient interest in the subject to justify the revival of the organisation. It was decided to test this by arranging an international conference in Paris, inviting as many people as possible from all parts of the world to attend, both to summarise the results of their recent researches, and also to indicate what kind of support they would be prepared to give to a revived committee.

The original purpose of the C.I.L. was, however, considered to be too restricted, and it was proposed to expand the interests to include all problems of light and living. Consequently papers were invited from lighting engineers, architects, physiologists with specialist interests in the eye, and ophthalmologists. Fifty-four papers in all were prepared for the congress during the brief space of three whole days.

The first day was devoted to the physiological effects of light, taking visual effects and the effect of radiation on the skin altogether during the one session. The second day was devoted to physical and climatical fundamentals. This included problems of natural lighting and also of artificial lighting and, once again, the visual and other effects were taken together. The third day was devoted to germicidal lamps and to the therapeutical action of light. The final day was devoted to a consideration of the work of the congress.

It was obvious right from the start of the conference that there was going to be a considerable divergence of interests because of the clear distinction between the original object of the C.I.L., that is to say, the problem of photo-biology, and the interests of the members of the congress who were primarily concerned with the visual aspects. It was extremely difficult for the chairman of the meeting to organise a properly conducted discussion because half the members of the congress were not interested in matters of vital importance to the other half. This was particularly noticeable in the discussions on natural and artificial lighting.

The first day's proceedings, physiological and pathological effects of light, was notable

for an excellent summary by Professor Le Grand on recent researches on vision. He referred to work on eye movements, on the frequency of blinking and its use as a test of visual fatigue, on the study of pupillary reflexes, on the problems of night myopia, and on the absorption of the crystalline lens and its variation with age. He also referred to recent work on retinal reactions, problems of flicker, retinal interaction and inhibition, and the effects of levels of illumination on visual acuity. Some questions were asked as to the possible harmful effects of ultra-violet or infra-red radiation on the visual mechanism. The lens normally acts as a kind of filter to ultra-violet light, thus preventing such radiation reaching the retina. As age advances the retina becomes more protected, since the transmission of the lens to ultra-violet light decreases. On the other hand, the lens itself is naturally more subject to changes arising from absorption effects. The rest of the papers were devoted to non-visual effects of radiation. Of particular importance was a communication by Professor Blum, of Princeton University, U.S.A. He reported work which demonstrates that light of wave-lengths between 3,000 and 5,000 Å enhances recovery from the action of short-wave ultra-violet radiation. This phenomenon is called "photo-recovery," and its wide distribution in the plant and animal world would suggest that it may also exist in man, although this has not yet been shown. Studies have been made of the erythemal threshold to short-wave ultra-violet radiation and subsequent treatment with light in the specified range. A slight effect is suggested, but experiments have been inconclusive. Obviously, photo-recovery must upset many ideas about the action of ultra-violet radiation. Professor Blub offered a suggestion, that the testing of materials for protection from sunburn and radiation in general must be done with the radiation actually to be experienced. The whole band of radiation must be present in the testing source, because there may exist two substances at least in the skin which have complementary reactions, such that irradiation with one wave-length may inhibit erythema from radiation with another wave-length.

There were eleven papers on natural lighting. The task of sandwiching these all into the space of one morning proved impossible and, naturally, something had to be left out. Professor Schulze, of Hamburg, summarised the results of his researches on the spectral composition of daylight both with and without sunshine, following closely the lines of his paper presented recently to the Stockholm conference of the C.I.E. The results are of some interest. Dr. Schulze also summarised current opinion on natural lighting in Germany and suggested methods of calculation. Of more immediate interest was the communication by Mr. G. Pleijel, of Stockholm, who summarised his recent researches on sun penetration. In this work he has taken into account not only the lighting effects of solar radiation, but also the heat penetration. He showed how the orientation of a building can be adjusted to make the maximum use of the available sunlight both for lighting and for heating. Such practical problems were discussed as the orientation and planning of a school building to enable the playground to dry out with early morning solar radiation, and so permit the children to get out into the open air at the earliest possible opportunity. Dr. Hopkinson, of the Building Research Station, reported some of the work which has been done there, using children themselves as observers to determine suitable levels of lighting in school buildings. Mr. D. J. Petty, of the Nuffield Provincial Hospitals Trust, who has been working with Dr. Hopkinson at the Building Research Station, described a model study which was made to determine the suitable planning of a hospital ward to achieve adequate and comfortable natural lighting. It was unfortunate that there was not time available for an adequate discussion of all these papers. The little discussion that was permitted showed that considerable interest is being taken on the Continent in problems of vision and natural lighting.

The afternoon session was devoted to the artificial lighting of buildings. The session was riddled by the preoccupation with the supposed harmful effects of fluorescent lighting, which seems to dominate discussion on artificial lighting on the Continent at the moment. In this country we find this rather disconcerting. For a number of years we have accepted the fluorescent lamp as one of the normal hazards of life, just as our fathers accepted the Welsbach mantle. It gives us, as the Welsbach mantle did, a very considerable increase in luminous efficiency of our light source. It also gives us colour rendering which is not always familiar to us but which we are rapidly becoming ready to accept. In France the use of fluorescent lighting has been banned in schools. In spite of considerable persistence in questioning all kinds of people, the real reason

for this ban could not be tied down to anything more definite than some form of popular scare. Nevertheless, it dominates all technical discussion on artificial lighting.

Amongst the various papers which were read was one entitled "Light from fluorescent lamps from the ophthalmological point of view," by Dr. Hermans, of Brussels. This dealt with the possible harmful effects of fluorescent lighting including flicker and the nature of the spectral composition. Dr. Hermans summarised a number of symptoms such as photophobia, unstable accommodation, migraine, and so on, which are said to be experienced by some people, and which he suggested were attributable to fluorescent lighting since they appeared and disappeared with presentation and removal of the stimulus. He suggested, however, that in most cases the fault was not so much with the nature of the light source as with the installation. He had some interesting remarks to make about the possible effect on the accommodation of the eye as a result of the discontinuous nature of the spectrum of the fluorescent lamp. Certain types of lamp emit a large part of their radiation at the short-wave end of the spectrum and another large bulk at the long-wave end. This "Dichroic" light may provoke accommodative instability. Because of the definite single maximum in the normal spectral luminosity curve, the eye, says Dr. Hermans, when working with a continuous radiation spectrum, acts as a quasi-monochromatic receptor. But with "dichroic" light it is not able to do so. These and other statements made in Dr. Hermans's paper did not appear to be sufficiently documented, and further information was asked for, but, unfortunately, the time available for discussion prevented these very important points being elucidated. In spite of the French preoccupation with fluorescent lighting problems they do not appear to have appreciated that the major difficulty associated with fluorescent lighting may well be the discomfort caused by the direct view of the bare light sources. This seems to have been missed in their concern about flicker and ultra-violet radiation.

The problem of flicker was discussed by Dr. Ségal, who has done a considerable amount of work on the problem of flicker with special reference to fluorescent lighting. The problem is exceedingly complicated, and his researches do not lead to an answer to the question—is fluorescent lighting and the flicker from such a discontinuous source harmful or not? He has devised a method of assessing visual fatigue which may be of considerable interest to fundamental workers in this country.

Dr. Latarjet, of Paris, read a summary on the consequences of ultra-violet light from sources used in the illumination of interiors. He has made a number of careful measurements which show that, provided the normal rules of illuminating engineering are obeyed in installing fluorescent lighting, no harmful effects should result, for the large majority of people, from the small amount of ultra-violet radiation emitted by these lamps. On the other hand, a certain amount of ultra-violet radiation does escape from fluorescent lamps, and Dr. Latarjet suggested that such radiation may have a certain germicidal activity on free viruses in conditions where a high level of fluorescent lighting is maintained for a long time. In view of the extremely complex situation revealed in later papers on the germicidal activity of ultra-violet radiation one was inclined to wonder if, in fact, it is possible to have one's cake and eat it. Dr. Latarjet's approach impressed one as being sound and comprehensive.

The papers which were given on the following day on the germicidal action of light and its therapeutical properties tended to leave a non-specialist with all his preconceived ideas turned upside down. On the other hand it revealed that a much more healthy attitude towards these matters is now being taken. It is no longer accepted that any situation which carries a certain risk of infection can be ameliorated merely by hanging up a lot of lamps radiating ultra-violet light. Distinctions can now be clearly made between situations which will benefit by radiation of a certain wavelength and situations which will not. Mr. J. Maisonneuve and Mr. A. G. Penny summarised the present position on the practical utilisation of radiation from electric light sources. Both papers gave a clear exposition of what can and cannot be done from the germicidal angle with electric light sources. A paper by Professor Hollaender, of Oakridge, United States, reported the results of a recent survey of the effectiveness of ultra-violet radiation in the control of airborne infection. The results of this work followed closely on comparable work which has been done in this country and demonstrate that the provision of ultra-violet radiation has little direct effect on the resistance of children to infection.

Not all the papers were up to the standard of those which have been mentioned. It was evident that the selection committee had some considerable difficulty and had failed to eliminate some papers which made firm

statements on what appeared to be inadequate evidence. If there had been sufficient time available these matters could have been hammered out in discussion, but unfortunately this was not possible within the extremely tight schedule.

The fourth session of the conference was devoted to the consideration of a number of conclusions which were intended to represent a summary of the average opinion expressed during these sessional meetings. Three of the delegates had been asked to present such summarised reports. Unfortunately, the reports were not presented in this way and were put forward from the platform in a form which appeared to suggest that they were technical resolutions of the conference. Some of the conclusions which were put forward, particularly those dealing with natural and artificial lighting, and with fluorescent lighting in particular, were felt by a number of the delegates to rest on insufficient discussion during the course of the main sessions. Finally, it was accepted that it would be wiser to conclude the conference without arriving at any agreed technical resolutions.

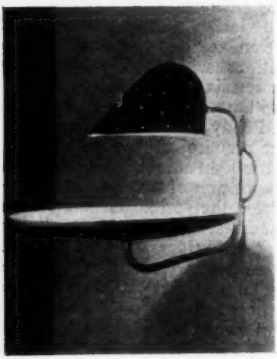
The conference served its immediate purpose, as it demonstrated that there is considerable interest in problems of photobiology, and that there is sufficient support available to revive the international organisation. It was also accepted that the expansion of the interests of the C.I.L. to overlap those of the C.I.E. was a mistake: dilution could well lead to extinction. Consequently, to avoid overlap, both real and imaginery, it was agreed to limit the activities of the C.I.L. to problems of photobiology, and it is understood that it is proposed to change the name of the organisation to the International Committee for Photobiology. The new secretary-general is Professor Harold Blum, of Princeton University, United States. The revived organisation expressed a keen desire to maintain close and friendly co-operation with the C.I.E. and with kindred bodies on matters of common interest.

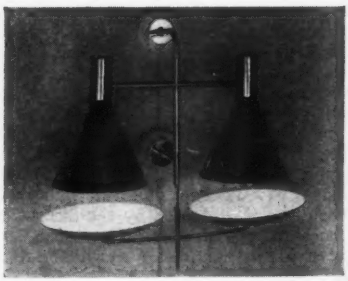
Contemporary Fittings for Northern Rhodesia

British contractors, architects and craftsmen are building a new luxury hotel at Lusaka, in Northern Rhodesia, and recently the Council of Industrial Design held an exhibition to show some of the furnishings and fittings which are to be used. The building, its furnishings and fittings, have been designed in one co-ordinated scheme to the best standard of contemporary design. The lighting fittings were designed by Mr. Dennis Lennon, who was also responsible for the colour scheme and the design of the furniture, and Mr. A. B. Read, R.D.I., and have been carried out by Troughton and Young.

The exhibition was most interesting, not only from the point of view of the new designs which have been produced, but also as an exercise in visualising the exhibits in the totally different surroundings for which they were intended.

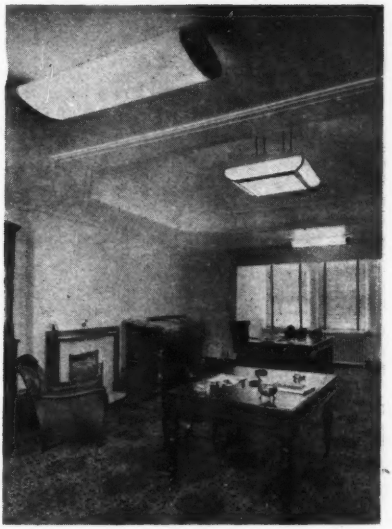
That the lighting fittings are in contemporary style will be seen from the two illustrated here: they cover a range of bracket, hanging and table fittings.





Two of the fittings specially designed for the Ridgeway Hotel, Lusaka.

New Lighting Installations

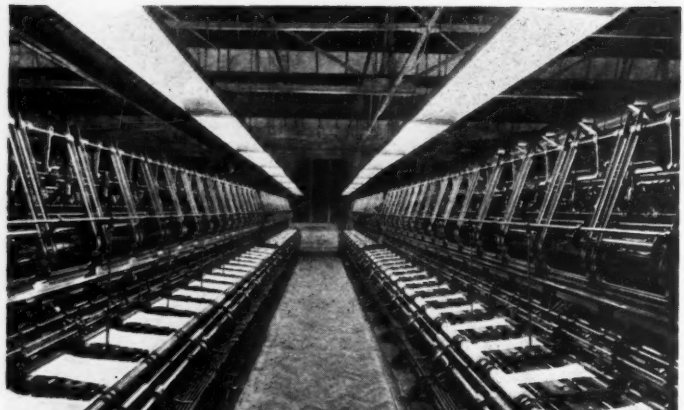


The new offices of the Southern Publishing Company, Ltd., who produce a number of local newspapers, at North-street, Brighton, have been lighted throughout by Thorn Electrical Industries, Ltd., using warm-white lamps. The illustration shows the managing director's office, the large central fitting in which contains eight 2-ft. 40-watt lamps, the two smaller fittings each containing two 5-ft. 80-watt lamps.

The lower picture on this page shows the attractive exterior of the "Chinacraft" shop at Hendon. The effectiveness of this kind of display is due almost entirely to the skilful use of concealed fluorescent lamps. In this installation the use of chandeliers in the centre of the shop gives a little extra warmth and sparkle to the interior. The installation was designed and installed by Modern Electric (Installations), Ltd.

(Above) Managing Director's office at the Southern Publishing Co. Ltd. offices, Brighton.

(Left) Shop at Watford Way, Hendon.



Fluorescent lighting for nylon stocking manufacture.

A Nylon Factory

The present manufacturing capacity of a new factory recently opened by Messrs. John Skelton and Co., Ltd., in a further effort to meet the insatiable demand at home and abroad for nylon stockings is 10,000 pairs a day.

Intricate and costly machinery is used for knitting the fine nylon yarn, and the entire manufacturing process requires high values of illumination with good penetration and a minimum of shadow. Metrovick illuminating engineers, who designed the lighting installation, have provided an illumination of 32/35 lm./ft.^{2} on the material at needle level by the use of single-

Lighting for seaming and finishing department in a nylon stocking factory.

lamp trough reflectors using 5-ft. 80-watt fluorescent lamps. The fittings, which are mounted in a continuous line at 7 ft. above floor level in rows 5 ft. apart are slotted to allow a percentage of upward light which gives the interior a more spacious appearance.

The stockings are knitted as one flat piece of material and then passed to the seaming and finishing department. In this department an illumination of 30/35 lm/ft.^{2} has been provided at working level, again with single lamp units, with an increase in the illumination to 40/45 lm./ft.^{2} at the far end of the room for the critical process of looping.

In any lighting installation small factors, such as the slotting of the reflector tops, add considerably to the efficiency of the lighting. In the photograph of the seaming and finishing department it will be seen that curtains have been provided for use with the artificial lighting. It is sometimes not realised that at night windows merely allow the light to pass out of the room, and that curtaining them would add considerably to the reflected light in the room.

Some 280 fittings are used in the installation, which was carried out by Messrs. John Skelton's own electrical staff.

An Aircraft Hangar

An aircraft maintenance hangar, 220-ft. long, 170-ft. wide and 65-ft. high at Whenuapai Airport, Auckland, New Zealand, has been lighted recently with 231 G.E.C. twin-lamp reflector fittings using 5-ft. 80-w. fluorescent lamps. The installation was designed by the Wellington branch of the British General Electric Co., Ltd., in co-operation with the New Zealand Ministry of Works, and employs wooden battens to support the fittings, suspended from wire catenary cables strung at 21-ft. centres, across the hangar, which is of reinforced concrete construction.

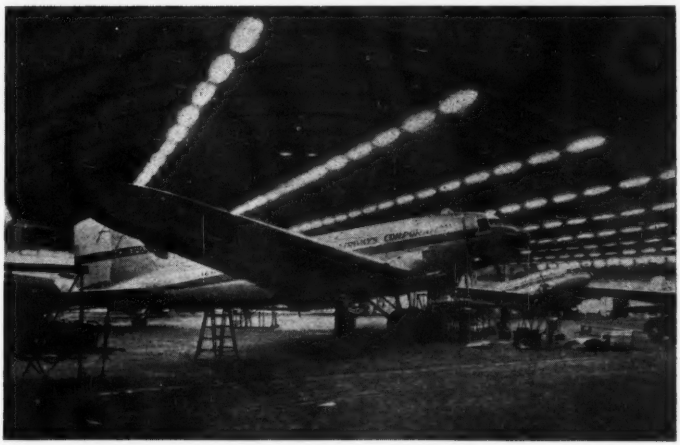
There are 11 rows of 21 fittings each spaced evenly across the hangar. The two side rows, which are mounted in the angle between the walls and the roof, are fitted with half reflectors only. The mounting height is 28-ft., and the scheme provides an illumination of 20 lm./ft.^{2} at the level of the aircraft engines.

Very favourable reports on the efficiency of the installation have been received from mechanics of the National Airways Corporation working on aircraft in the hangar. Whenuapai is primarily a R.N.Z.A.F. aerodrome.

A Farm Installation

The functional siting of lighting units with the emphasis on low angle illumination has recently been developed at Woolley Park Farm, Bradford-on-Avon, by McDonald and Brown, architects and surveyors, of Unity-street, College Green, Bristol, in conjunction with Simplex Electric Co., Ltd.

For years the dairy industry has been dissatisfied with the normal overhead lighting in cowsheds but for some reason the low-angled approach—which is essentially utilitarian and highly functional — was over-



Fluorescent lighting in a maintenance hangar in a New Zealand airport.

Low angled lighting units in a cowhouse at a Midland farm.

looked. The layman can clearly observe the benefit of low-angled lighting in milking operations and it was with this in mind that McDonald and Brown, who are specialists in the remodelling of farm buildings, developed this idea to a high degree of efficiency.

The photograph reproduced here is of the cowhouse at Woolley Park Farm where Simplex prismatic watertight fittings have been placed between the stalls so that the light is thrown up under the animal to assist in the milking operations by bucket plant. To ensure maximum safety the fittings, which incorporate 60-w. lamps, have been wired in conduit on 25-volt circuits controlled by a master transformer, the whole installation being carried out by Lamberts (Bath), Ltd., Electrical Contractors, 16, Broad-street, Bath.

Interior of Kodak Ltd. showroom lit by Benjamin indirect lighting units.

I.E.S. ACTIVITIES

London

At the London sessional meeting on November 13, a paper on "The Equipment and Functions of an Illumination Laboratory" was presented by Mr. H. F. Stephenson.

The function of an illumination laboratory is to investigate problems in the utilisation of light. Requirements vary from those of small laboratories confined to the routine testing of a limited range of lighting fittings, to those of the larger laboratories, which may include the study of lighting systems and lighting applications in addition to the design, development and appraisal of lighting equipment of many different kinds. Photometric measurement is an important tool, but it is only one of many which are needed.

The paper reviews typical problems arising in a large illumination laboratory and the apparatus and techniques used in their solution. The first part dealt with the photometric testing of lighting equipment which is a function of all illumination laboratories. A brief reference to the need for a proper understanding of the significance of photometric measurements was followed by a short review of basic photometric equipment such as reference lamps, photometric bench and electrical supplies and instruments.

The photometric performance of lighting equipment is usually examined on light distribution photometers. The choice of measuring technique is determined by, among other factors, the minimum distance needed for the inverse square law to be applied with sufficient accuracy, and the change in the characteristics of some lamps if tilted or rotated. The essential features of polar co-ordinate and turntable distribution photometers were discussed and illustrated by typical examples. For large lighting fittings used at small mounting heights, such as fluorescent lamp fittings, this minimum distance greatly exceeds the mounting height. In these cases equilux or illumination diagrams are prepared for the required range of mounting heights. A fitting rotator which facilitates the preparation of these diagrams was described.

Photoelectric methods are frequently used in distribution photometry and, for the accuracies required, the photovoltaic cell used with a reflecting galvanometer and scale is convenient. The characteristics of photocell/galvanometer combinations and precautions necessary in their use were discussed, and simple apparatus for checking the linearity of the combination by the summation method, and of the galmanometer itself, are described.

The most useful and versatile instrument in the illumination laboratory is the visual illuminometer. It measures illumination and luminance and can often be adapted for telephotometry and for use with other instruments. Photography also is a valuable research tool, and is, perhaps, the only way of recording the visual impression produced in an installation. Elaborate techniques such as photographic photometry are often useful, but are difficult.

The second part of the paper reviewed the more important non-photometric testing procedures, tests under service conditions and the techniques used in the study of lighting applications. Lighting equipment involves problems of heat as well as of light and many thermal tests are needed. Equipment and techniques are described for temperature measurement and for the study of convection streams in and around lighting fittings, and thermal shock tests on glassware and associated problems were dealt with. The paper also discussed life testing of lighting fittings, tests for corrosion and weather-proofing and many optical and mechanical tests needed on component parts of lighting equipment.

The paper concluded with a discussion of the requirements of a building suitable for an illumination laboratory.

Birmingham Centre

The opening meeting of the 1951-52 session of the Birmingham Centre was held on October 12 when the new Chairman, Mr. R. A. Lovell, gave his address. This took the form of a paper, with lantern slides and demonstration of "Lighting in the Potteries." The paper was notable, not only for its erudition, but also for the introduction of such amusing and intriguing trade names as blungers, pugmills, sagger, jigger, thrower, spriggs and glost.

Mr. Lovell described the working of a pottery beginning at the sliphouse from whence emerges slip, a watery clay used for

casting and a pugged clay for throwing, and then right through to the packing department. He described various processes, such as making, placing, glazing, colouring and the problems encountered in lighting them to the best advantage.

Mr. G. Redmond, in proposing a vote of thanks, suggested that the paper should be heard, with advantage, by all pottery manufacturers; the vote of thanks was seconded by Mr. D. Lewin.

An interesting and instructive evening meeting of Midland members of the I.E.S. was held in the lecture room at the Rugby Works of the British Thomson-Houston Company on September 29. There were about 50 members present when Mr. M. E. Bellchambers presented a paper on "Light Sources in Inspection." Mr. Bellchambers claimed that inspection in the early stages of manufacture justified its expense. He then proceeded with several demonstrations, in which he used practically all the various modern light sources and covered a very wide range of practical applications.

Glasgow and Edinburgh

The opening meetings of the two Scottish centres were well attended by both members and visitors. At both meetings Mr. E. W. Murray, of the Industrial Museum of the Ministry of Labour and National Service, gave a lecture on lighting and the prevention of industrial accidents. The paper was very well received by the mixed audiences which included visitors from a number of industrial concerns, and very interesting discussions ensued.

Manchester Centre

The annual luncheon of the Manchester Centre was held at the Midland Hotel, Manchester, on October 11. Over 100 members and guests were present and the chair was taken by Mr. J. Martin.

The toast of the City and Port of Manchester was proposed by Mr. Alan H. Owen who, after many years as secretary and assistant secretary of the Centre, is now vice-chairman. He referred to the importance of Manchester in commerce and the lead it had given in such matters as industry and education. The reply was made by the Lord Mayor of Manchester, Councillor William Collingson.

The toast of the I.E.S. was proposed by Mr. N. G. Fisher, chief education officer of the City of Manchester, who expressed his admiration of the altruistic aims of the Society and said that he was pleased to be connected with it through the Manchester College of Technology and in connection with the lectures to school children. He said it seemed that since the war we in this country had not been able to take advantage of the technical advances which had been made in illumination in the same way as had some other countries, and he hoped that in the next few years we would be able to reap more benefit from our labours. He was particularly interested in the lighting of schools, in which field some progress had been made. The I.E.S. was partly responsible for this and for the recognition of the importance of daylighting, which had revolutionised school design. The activities of the I.E.S., he said, were far-reaching, and he wished the Society every success in its work.

Mr. J. G. Holmes, president, replied for the Society and thanked the Lord Mayor for maintaining the tradition of the Centre by being present at the lunch. He also congratulated Mr. Martin on being the first member of the Society to have been chairman of two Centres, he having been chairman of the Leicester Centre some years ago.

He thanked Mr. Fisher for his remarks, and emphasised the close link between the Society and education. He said he was glad to hear of the support given by the Manchester education authorities to the lectures to school children and he expressed the appreciation of the Society for the great assistance given by the College of Technology in connection with the City and Guilds examinations. He said that the Society was most anxious to encourage students and that there would shortly be an announcement concerning the Dow Memorial Prize, which would be for a competition intended to encourage collaboration between students of lighting and students of architecture. He asked the Centre to encourage the submission of entries for the competition in due course. He also drew attention to the Silver Jubilee Commemoration Award which was open only to student members of the Society but which had been awarded only once in several years.

Sheffield Centre

The opening meeting of the Centre was held on October 1, with an address from the new chairman, Mr. G. L. Tomlinson, who reviewed the history of tariffs in the electrical supply industry with particular reference to the influence of the lighting load.

Mr. Tomlinson gave a very interesting but necessarily brief, survey of the development of tariffs in the electricity supply industry from the very early days. He

illustrated his talk with some very interesting slides extracted from the statement of accounts of the early Sheffield undertaking. This was established as a private company in the year 1892 and was taken over by the Corporation in the year 1898. These slides illustrated very well the characteristics of the lighting load as this was practically the only load at that time. It was on this class of load that the tariffs of that time were in consequence based. From this point onwards he traced the gradual development of electricity into the wider sphere of power, heating, etc., and showed how, as overall load factor increased, i.e., as better use was being made of the plant available, so it was possible to reduce the charges. The need, he pointed out, was to have regard to the equity of charges as between one class of consumer and another, and showed that, although from a layman's point of view the common flat rate would appear to be the simplest method of charge, such a rate was in fact inappropriate and inequitable.

The influence of the lighting load even in these days of the multiplicity of use of electricity had contributed to the peak demand, particularly in the afternoon. The important thing was diversity, and this was a factor that was most difficult to assess. In general, as far as the lighting load itself was concerned there was, of course, diversity between the connected load and the actual demand, but there was little or no diversity in relation to the demand itself which inevitably always made its presence felt at the same time.

Lighting engineers, in the designing of lighting schemes, had to give consideration not only to illumination levels but also to the capital costs involved and the running costs and tariffs were therefore of considerable importance. The point was of significance when it came to a comparison between two different types of lighting, say tungsten and discharge lighting. Each case would, of course, have to be considered on its merits, and Mr. Tomlinson produced two charts giving details of a hypothetical lighting scheme carried out in tungsten or, alternatively, in fluorescent with a comparison of total costs of the two alternative schemes, which indicated quite clearly the effect of the tariff on the economics of the two schemes.

North Lancashire Group

The first meeting of the newly formed North Lancashire Group was held at the Playhouse Theatre, Preston, on October 16, when the chairman of the new group, Mr. J. D. Ducker, officiated. The proceedings were opened by the Mayor of Preston, Councillor J. W. Taylor, J.P., who referred to the long association of Preston with electric lamps and illuminating engineering. He also spoke of the cultural and technical activities of the Society and said he was very pleased that the Society had formed this new group with its headquarters in Preston.

Dr. J. N. Aldington, on behalf of the Society, thanked the Mayor for his remarks. He said that though the majority of those present at the meeting were probably associated with the electrical industry in one way or another, it should be remembered that the Society drew its members from many industries and occupations as the Society was interested in all aspects of light and its applications.

Mr. H. Hewitt then gave his paper on "Lighting of Fibre and Fabric," which was based on the paper he gave at the I.E.S. summer meeting at Buxton. In the presentation of the paper he was assisted by the Preston firm of Horrockses, Crewdson and Co., Ltd., who supplied a display of different fabrics on which Mr. Hewitt was able to demonstrate various kinds of lighting. The discussion on the paper was opened by Mr. J. S. Smyth.

The meeting was very well attended and was a most successful start for the new group. Had it not been for the pending General Election (arranged without reference to the group) the attendance at the meeting would no doubt have been even greater. As it is, the group already has 55 members and continues to grow.

Glassworks Visit

A most interesting visit was paid on October 24 to the Whitefriars Glassworks of James Powell and Sons (Whitefriars), Ltd., at Wealdstone, when a party of I.E.S. members saw the manufacture of glass from the initial stages and the production of a range of glassware. Particularly impressive was the making by hand of the crucibles in which the mixture of raw materials is melted to make glass; the visitors were also impressed by the skill of the workers in manipulating and shaping the molten glass. The making of stained glass windows was also most interesting, and the party saw completed windows which had been designed and made by the firm for the Middle Temple.

Another has been arranged to take place on the afternoon of Wednesday, January 16. As places are limited, those wishing to take part should write to the I.E.S. Secretary as soon as possible.

Forthcoming I.E.S. Meetings

LONDON

December 11th

Sessional Meeting. "Dark Adaptation and Miners' Nystagmus," by W. J. Wellwood Ferguson. (At the Lighting Service Bureau, 2, Savoy Hill, W.C.2.) 6 p.m.

CENTRES AND GROUPS

December 4th

CARDIFF.—"Lighting of the New House of Commons," by C. Dykes Brown. (At the Demonstration Theatre, S. Wales Electricity Board.) 5.45 p.m.

LIVERPOOL.—"Whither Gas Lighting," by G. W. A. Illingworth. (At the Liverpool Engineering Society, 9, The Temple, 24, Dale Street, Liverpool, 2.) 6 p.m.

STOKE-ON-TRENT.—"Shop and Store Lighting," by A. W. Jervis. (At 31, Kingsway, Stoke-on-Trent, 6 p.m.

December 5th

NEWCASTLE.—"Black Light—its effect and application," by H. L. Privett. (At the Minor Durrant Hall, Oxford Street, Newcastle-on-Tyne, 1.) 6.15 p.m.

SWANSEA.—"Lighting of the New House of Commons," by C. Dykes Brown. (Joint Meeting with the Electrical Association for Women.) (At the Minor Hall, Y.M.C.A., Swansea.) 6.30 p.m.

December 6th

NOTTINGHAM.—"The Design and Development of New Lighting Fittings," by L. W. V. Turner. (At the Demonstration Theatre, East Midlands Electricity Board, Smithy Row, Nottingham.) 5.50 p.m.

EXETER.—"Lighting for the Prevention of Industrial Accidents," by E. W. Murray. (At the Providence Hall, Northernhay Street, Exeter.) 7 p.m.

December 7th

BATH AND BRISTOL.—"Lighting for the Prevention of Industrial Accidents," by E. W. Murray. (At the S. Western Electricity Board Lecture Theatre, Colston Avenue, Bristol.) 5.30 p.m.

BIRMINGHAM.—"The Architect's Approach to Artificial Lighting," by R. G. Cox. (At the Imperial Hotel, Temple Street, Birmingham.) 6 p.m.

HUDDERSFIELD.—"Lighting in the New House of Commons," by C. Dykes Brown. (At the Electricity Showroom, Market Street, Huddersfield.) 7.15 p.m.

December 10th

LEEDS.—"Architecture and Lighting," by a member of the staff of the Building Research Station. (At the Lighting Service Bureau, 24, Aire Street, Leeds, 1.) 7 p.m.

December 12th

EDINBURGH.—"Light and Crime," by W. Merrilees. (At the Welfare Club Hall, 357, High Street, Edinburgh.) 7 p.m.

December 13th

GLASGOW.—"Church Lighting," by L. C. Rettig. (At the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, C.2.) 6.30 p.m.

LEICESTER.—"What I have learned about Lighting from the Festival," by T. O. Freeth. (At the Demonstration Theatre, East Midlands Electricity Board, Charles Street, Leicester.) 6.30 p.m.

MANCHESTER.—"Brightness Engineering," by W. Robinson. (At the Demonstration Theatre of the Manchester Town Hall Extension.) 6 p.m.

December 14th

CARDIFF.—Dinner Dance.

December 19th

TEES-SIDE.—"Street Lighting," by A. J. Ogle. (At the Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough.) 6.30 p.m.

December 20th

GLOUCESTER AND CHELTENHAM.—"Light as an Aid to Crime Detection," by C. H. Edlin. (At the Cadena Cafe, High Street, Cheltenham.) 6.15 p.m.

Trade Literature

ASHLEY ACCESSORIES, LTD. New leaflet on components including ceiling switches, ceiling roses, lamp-holders, etc.

EDISON SWAN ELECTRIC CO., LTD. New pamphlet giving fullest details of C.M.A. wiring cables for farms.

EKCO-ENSIGN ELECTRIC CO., LTD. (i) Folder on industrial lighting equipment for use with tungsten filament lamps, including dispersive, concentrating, angle and local lighting reflectors, prismatic bulkhead fittings, floodlights, etc. (ii) Illustrated catalogue on the range of Ekco tungsten filament and fluorescent lamps covering all domestic, commercial, and industrial requirements. (iii) Leaflet on decorative fluorescent fittings and (iv) leaflet on industrial fluorescent fittings, including 80w. 5 ft., 40w. 4ft., and 20w. 2 ft. fittings.

FALK, STADELMANN AND CO., LTD. Catalogue 788 covering complete range of "Hitest" cables and flexibles, "Coolex" ironclad switchgear, "Efesca" and "Falks" electrical accessories, "Climax" conduit and conduit fittings.

GENERAL ELECTRIC CO., LTD. New catalogue giving details of the principal types of Osram lamps for general and special lighting services.

KNIGHTSHADES, LTD. Booklet giving illustrated details of table lamps, fittings, bedlights and lampshades.

METROPOLITAN VICKERS ELECTRICAL CO., LTD. Folder on entirely new range of fluorescent lighting fittings. Also booklet describing all types of lamps with prices.

PHILIPS ELECTRICAL LTD. New publications including general lamp catalogue listing over 3,000 different lamps covering all applications; apparatus and fittings price list; lamp folder, motor-car bulb folder; tungsten, blended and mercury lamp fittings broadsheet with prices; instant self-start lighting system broadsheet with prices.

THORN ELECTRICAL INDUSTRIES, LTD. Atlas fluorescent lighting handbook, giving detailed information on the extensive range of Atlas fluorescent lighting units for industrial, domestic and commercial purposes.

THE TINTOMETER, LTD. "Electric Eyes," by A. J. Fawcett. Information on the photo-electric cell for colorimetric work, giving its uses, advantages, and disadvantages. A glossary of terms used has also been included.

VENNER TIME SWITCHES, LTD. Descriptive leaflet on the Venner-type T.J.S.P.—an electrically-wound time switch carrying spring reserve power to maintain the clock during power cuts.

New E.D.A. Film

The new E.D.A. educational film "Out of the Dark" runs for 27 minutes and can be highly recommended for showing to a wider audience than schoolchildren for whom it was originally intended. I.E.S. Centres and Groups, for example, might well use it for an informal meeting as well as for their lectures to schoolchildren.

Produced at Merton Park Studios, this film traces, the growth of lighting and methods of producing illumination, starting with the early stone lamps and rush lighting up to the use of candles, gas and finally electricity. The commentators in the film are Dr. Arthur Bryant, the historian, who concentrates on the historical aspect of the story of lighting and Professor C. Andrade, Director of the Royal Institution of Great Britain, who commentates on the scientific side.

In producing this and other films ("Electricity and Light," for example, produced earlier in the year) E.D.A. are making a notable contribution to the field of visual education. These 16 mm. films are available for free loan on application to B.E.D.A., 2, Savoy-hill, W.C.2.

Vacuum Research

A new quarterly journal "Vacuum" published by W. Edwards and Co. (London), Ltd., of Worsley Bridge-road, S.E.26, has appeared this year. Though produced by one of the leading firms in the field of vacuum engineering it is not an Edwards house journal and is intended as an authoritative publication designed to advance high vacuum technology. Issues to date have included articles by a number of international specialists. Subscripion rates are £1 5s. (£1 10s. overseas).

Binders for "Light and Lighting"

This issue being the last of the year many readers, who will no doubt wish to keep the whole volume for handy reference, will be interested to know that special binders are now available. Each binder holds twelve copies which can be inserted securely without being punched or defaced in any way. In green leather cloth, with stiff covers and the title goldblocked on the spine, these binders would make a handsome addition to any bookshelf. Cost, including postage and packing, is 12s. 6d. Orders should be sent to "Light and Lighting," 32, Victoria-street, S.W.1.

Personal

At the end of November Mr. E. W. MURRAY retired from his position as Curator of the Ministry of Labour Safety, Health and Welfare Museum at Horseferry-road, Westminster. Mr. Murray was transferred from the Engineering Branch of the Office of Works to the preparatory work of the museum in 1925 and he has been curator since the museum was opened in 1927. During this long period Mr. Murray has become widely known and he has lectured at many places throughout the country on safety in factories. He made a particular study of lighting and accident prevention and he has held a number of offices with the I.E.S. Our best wishes to Mr. Murray for a long and happy retirement.

Mr. R. P. SAYERS has relinquished his position as assistant commercial manager of the Light Group of Philips Electrical, Ltd., and has joined Ashley Accessories, Ltd., of Ulverston, Lancs., as sales manager. Mr. Sayers is a Fellow of the I.E.S. and a Registered Lighting Engineer.

Dr. W. D. WRIGHT, whose work on colour and vision is well known, has been appointed Professor of Technical Optics at Imperial College.

Mr. R. W. STEVENS, who is with Siemens Electric Lamps and Supplies, Ltd., as a lighting fittings designer, has been elected a member of the Society of Industrial Artists.

SITUATIONS VACANT

An interesting vacancy as LABORATORY ENGINEER will shortly occur, suitable for a young Electrical Engineer having an interest in Lighting. Some knowledge of photometry is essential and applicants must have a natural desire for laboratory work. Location: N.E. London (outer). Pension scheme in operation. Apply, giving full details of qualifications and experience, to Box No. 819.

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POSTSCRIPT

By "Lumeritas"

Table lamps, and doubtless other lighting units, have often been given as birthday presents, but I wonder how many people have received a gift of light on their birthday? One who has is Provost Sir John Sheppard, of King's College, Cambridge. For his 70th birthday the college conceived the idea of giving Sir John light by way of flooding the college windows with it. A local firm was commissioned to deliver this birthday present and they have used thirty-three floods to do it. I understand the effect is very good.

The new pedestrian crossing arrangements are coming in for a good deal of criticism, and one daily paper has published an article whose author considers "the famous Zebra, is a flop." In this article, one of the writer's charges is that "the Zebras are impossible at night. Lighting is totally inadequate. What is required is a special and recognisable lighting system that will indicate a crossing. The high lamps are useless, particularly on a wet night, when sudden braking can be dangerous to pedestrian and motorist alike." I think this charge is justified, and something needs to be done to make the crossings more easily visible to vehicle drivers at night. If a special lighting system is used there are several possibilities. Floodlighting is one, and I believe this has been tried and found wanting. Illuminated beacons are being used, but these seem to me to be not sufficiently conspicuous. As far as I know a flashing light has not been tried, but I would expect it to be most effective. No doubt installation costs would be relatively high but they may be justified by results.

A reverend gentleman writing recently to the editor of the "Daily Telegraph" remarked—apropos a definition of "lumen"—how complicated life is becoming! He was, he said, under the impression that "lumen" is the Latin word for "light" but, having occasion to peruse the Revised Standards for School Premises Regulations, just issued by the Ministry of Education, he found "lumen" defined as follows: "'Lumen' means the luminous flux emitted in unit solid angle by a uniform source of artificial light giving a luminous intensity of one candela." Most of us who have some knowledge of lighting terminology will feel some sympathy for the cleric who has to assimilate this. My own difficulty is to understand why the word "artificial" is included in the definition, since *any* uniform light source of unit intensity (if one were known) would emit one lumen per unit solid angle. A Group Captain writing from Edinburgh to the same paper to shed some light on "lumen" asked what other term the reverend gentleman would prefer, and whether he is "perplexed by the standard unit of measurement 'square foot,' because no man's foot is in fact square?" I wonder what would have been the reverend gentleman's reaction to the term "foot-candle," and why he expressed no perplexity about "candela"?

In the middle of October a football match between Arsenal and Glasgow Rangers was played by night on the floodlighted ground at Highbury. Sixty-two thousand people paid to see the match, the gate-money amounting to more than £10,000. Commenting on this, a newspaper football reporter said, "Money talks. Here it is shouting that organised competitive football by artificial light is bound to come." I believe this has not yet been authorised by the Football Association, but, apparently, representatives of the Scottish Football Association who were at the match were much impressed by the possibilities.

This year is the centenary of Helmholtz's invention of the ophthalmoscope. The object of this instrument is to direct light into the eye in such a way that the illuminated living retina can be seen by the user of the instrument. Many modern ophthalmoscopes have self-contained light sources operated either from a dry battery or from a small transformer connected to the mains. In his autobiographical notes Helmholtz refers to the elation he felt on being the first man to see inside the living eye. He was, however, not quite the first to have this experience for, some years earlier, a Scottish oculist—Cumming by name—had seen the fundus of the intact eye, and so also had Purkinie, whose name is known to lighting people chiefly because he drew attention to the change in spectral sensitivity of the eye which occurs during the transition from photopic to scotopic levels of illumination—a change which is known as the Purkinje effect.

Vol. XLIV.—1951

Authors Index

A PAGE

ALDINGTON, J. N. Electric Lamps—A Decade of Progress 269

B

BEGGS, S. S. The Lighting of Aerodrome Control Rooms 93
BESEMER, B. F. W. Random Review of 1950 21

C

CAHEY, J. C. Fluorescent Lighting for Offices 166
CHAPMAN, D. F. Load Shedding and Light Sources 341
CLACK, F. J. G. Lamps for Street Lighting 383
COLE, G. F. Commission Internationale de l'Eclairage 295
COLLINS, P. H. Plastics for Street Lighting Equipment 378
CORNELIUS, F. Spun Prestressed Concrete Lighting Columns 317
CUNNINGTON, A. Some Views on the Lighting of Station Names 178

F

FRISBY, J. K. Fluorescent Lighting in the Hospital 89

H

HARPER, W. E. Plastics for Street Lighting Equipment 378
HARRISON, W. Assessment of Colour Rendering Properties of Fluorescent Lamps 148
HASSEL, G. School Lighting in Sweden 250
HOLMES, J. G. Post-War Development in Fittings Design 309
HOLMES, R. R. Brightness Terms ... 238
HOPKINSON, R. G. Lighting Research at the Building Research Station ... 10
Influence of Recent Research on School Lighting 81
HULL, J. N. High Bay Lighting with Mercury Vapour Lamps 28

J PAGE

JOHNSON-MARSHALL, S. A. Recent Trends in the Design of Schools ... 138

L

LUCKING, E. E. Window Display Lighting 45

N

NASH, A. H. Fluorescent Lighting for Offices 166

O

OLSEN, A. H. Display Lighting and Modern Store Design 49

P

PENNY, A. G. Lamps for Street Lighting 383
PLEIJEL, G. Lighting Economy and Building Construction 147
PULMAN, R. Screen Visibility in the Motion-Picture Theatre 197
Projector-Arc-lamps for Motion-Picture Presentation 335

R

READ, A. B. Lighting the Way 274
REILLY, P. Industrial Design and the Lighting Industry 87
ROPER, J. F. Fluorescent Lighting in Schools 173

S

SAMPSON, H. O. Television Studio Lighting 201
SAMUEL, E. F. Recent Trends in the Design of Schools 138

T

TATE, R. L. C. Lighting the Small Specialist Shop 47

W

WALDRAM, J. M. Lighting Aims and Techniques 331
WATTS, H. E. Fluorescent Street Lighting—the First Five Years ... 387
WESTON, H. C. Visual Tasks in Schools 64
Bases for Recommended Values of Illumination 349

Subject Index

A PAGE

Aerodrome Control Rooms, The Lighting of 93
Aims and Techniques, Lighting 331
A.P.L.E. Conference at Brighton 365
Association Française des Eclairagistes 252

B PAGE

Bakeries, Lighting for 68
Belgian Code of Practice for Street Lighting 241
B.E.P. Convention 278
Book Reviews 75, 261, 288, 324
Brightness Terms 238
British Industries Fair, 1951 210

B

PAGE

Building Construction, Lighting Economy and 147
Building Research Congress 410
B.R.S., Lighting Research at the 10

C

Canterbury Cathedral, Lighting in ... 161
Cathedral, Fluorescent Lighting in a ... 401
C.I.E. Meeting 264, 295
City and Guilds Results and Courses 325, 394
Code of Practice for Street Lighting, Belgian 241
Colour Group 146, 158, 231
Colour Matching Lamps in Display... 60
Colour Rendering Properties of Fluorescent Lamps, Assessment of 148
Comité International de la Lumière, 1951 Paris Conference 423
Concrete Lighting Columns, Spun Prestressed 317
Control of Fluorescent Lamps 33
Correspondence 99, 137, 185, 243, 289, 323, 356

D

Department Store in Plymouth, New 404
Display Lighting 45, 53, 60, 62
Display Lighting and Modern Store Design 49

E

Electric Lamps—A Decade of Progress 269

F

Festival of Britain, Preview of the South Bank Exhibition 119
Festival Exhibitions 283
Festival Hall, The Royal 233
Festival Lighting 244
Fittings Design, Post-War Developments in 309
Fluorescent Lamp Production 226
Fluorescent Lamps, Control of 33
Fluorescent Street Lighting—the First Five Years 387

H

High Bay Lighting with Mercury Vapour Lamps 28
Hospital, Fluorescent Lighting in the 89
House of Lords, Reinstatement of 267

I

I.E.S. Activities 37, 73, 111, 153, 187, 257, 357, 431
I.E.S. Annual Dinner 206
Industrial Design and the Lighting Industry 87

L

Lamp Production, Fluorescent 226
Lamps, Electric—A Decade of Progress 269
Lamps for Street Lighting 383
Lighting Fittings 108, 223, 320
Lighting the Way 274
Load Shedding and Light Sources 341

M

PAGE

Medical Aspects of Light 423
Mercury Vapour Lamps, High Bay Lighting with 28
Mint, Lighting at the Royal 276
Motion-Picture Presentation, Projector-Arc-lamps for 335
Motion-Picture Theatre, Screen Visibility in the 197
Motor Show, Lighting at the 408

N

New Lighting Installations 34, 105, 180, 280, 352, 427
N.I.C. Annual Report of 189

O

Offices, Fluorescent Lighting for 166

P

Physical Society Exhibition 170
Plastics for Street Lighting Equipment 378
Projector-Arc-lamps for Motion-Picture Presentation 335

R

Random Review of 1950 21
Research, Lighting at the B.R.S. 10
Reviews of Books 75, 261, 288, 324
Royal Festival Hall 223

S

School Lighting Fittings 223
School Lighting, Influence of Recent Research on 81
School Lighting Installations 213
School Lighting in Sweden 250
Schools, A Review of Lighting Conditions in 5
Schools, Fluorescent Lighting in 173
Schools, Recent Trends in Design ... 138
Schools, Visual Tasks in 64
Screen Visibility in the Motion-Picture Theatre 197
Ship Lighting 345
Shop Lighting .. 47, 49, 54, 56, 58, 60, 62, 404
South Bank Exhibition, Preview of ... 119
Spun Prestressed Concrete Lighting Columns 317
Station Names, Lighting of 178
Steel Company of Wales 417
Street Lighting, Belgian Code of Practice for 241
Street Lighting Equipment, Plastics for 378
Street Lighting, Fluorescent 144
Street Lighting, Fluorescent—the First Five Years 387
Street Lighting Installations ... 100, 254, 376
Street Lighting, Lamps for 383

T

Television Studio Lighting 201
Theatre, The Old Vic 71
Trotter-Paterson Memorial Lecture ... 42
Tungsten Ballast Circuits 33
Tungsten Lamp, The Development of the 97

V

Values of Illumination, Bases for Recommended 349
Visual Tasks in Schools 64

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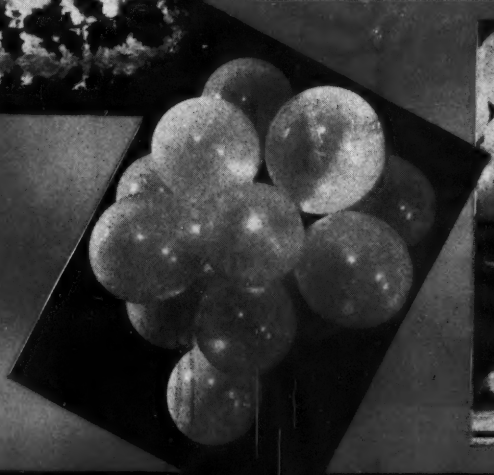

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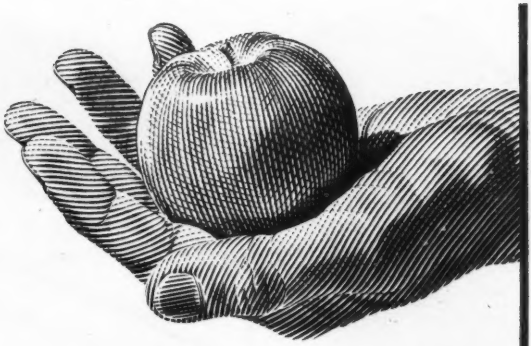

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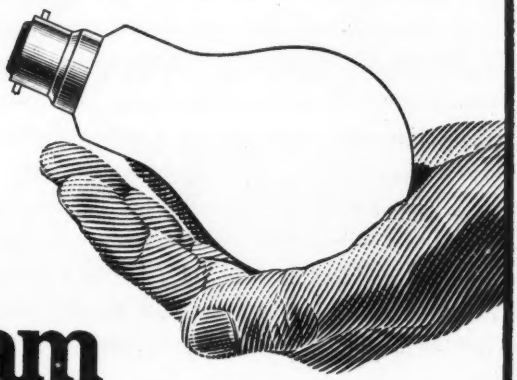

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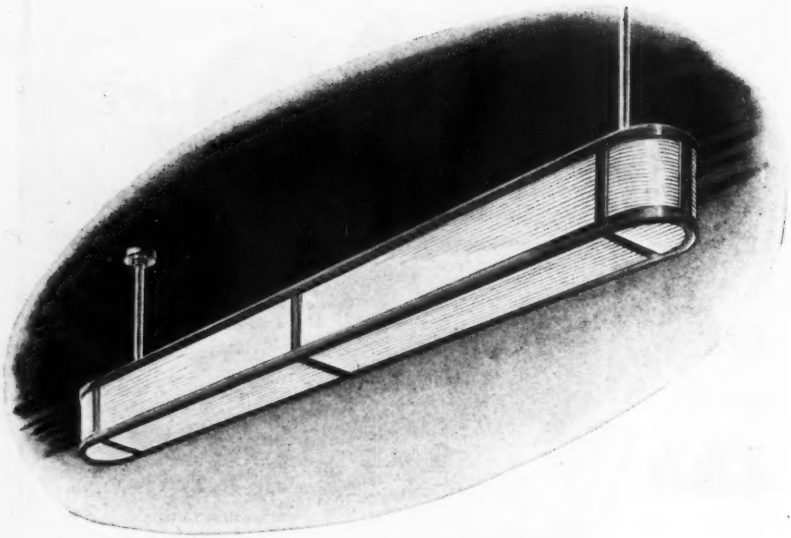

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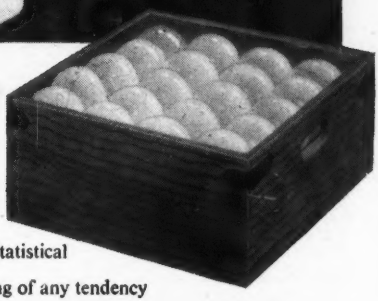

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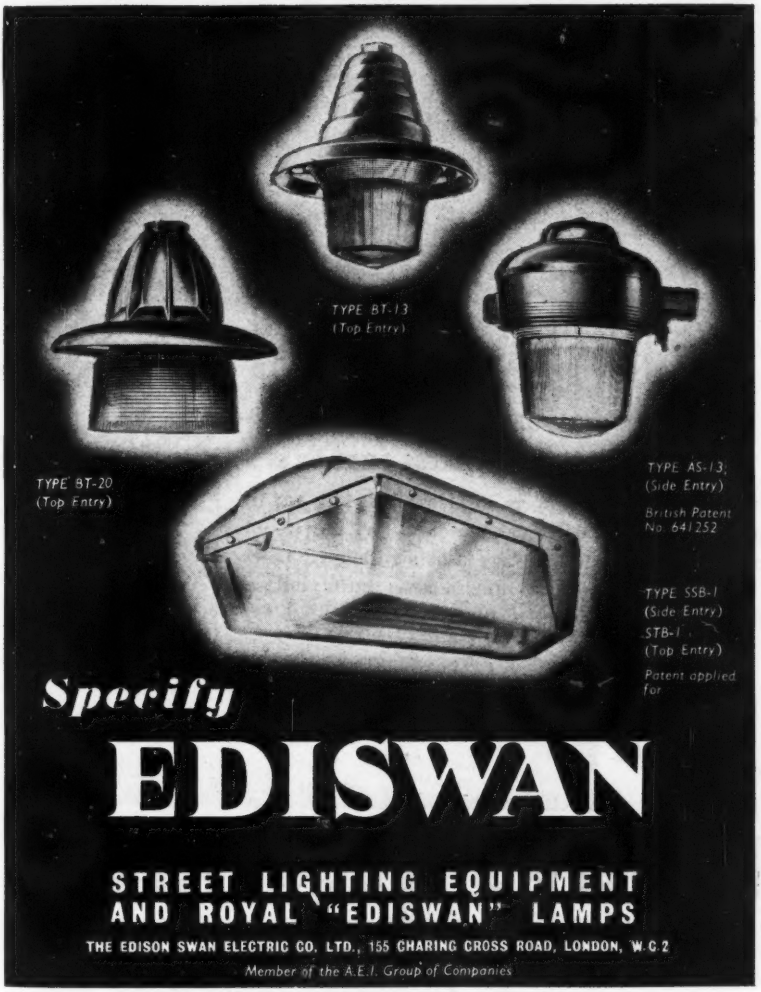

Specify

EDISWAN

STREET LIGHTING EQUIPMENT
AND ROYAL "EDISWAN" LAMPS

THE EDISON SWAN ELECTRIC CO. LTD., 155 CHARING CROSS ROAD, LONDON, W.C.2

Member of the A.E.I. Group of Companies

OBNUBILATION

(The act of obscuring, darkening)

in the office, causes

SLOW WORK · CARELESS MISTAKES · LOW MORALE

IN AN OFFICE where tempers are short, faces long and the work slow and inefficient, the cause of the trouble often vanishes away simply by installing Philips Fluorescent Lighting, planned to bring a clear, restful, diffused light to every desk in the room.

The handsome "Abingdon" fitting contains two 80w. 5 ft. Philips fluorescent lamps. Other suitable fittings for offices :—"Alva" and "Arundel".

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Makers of: Radio & Television Receivers, "Philishave" Electric Dry Shavers, etc.

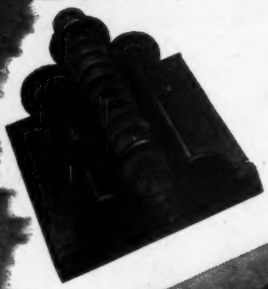
(LD963)

Better light makes life brighter

The all out armanent drive calls for good lighting not only to ensure accurate work but also to keep up the morale of workers of whom so much is demanded. A cheerful factory, bright with good lighting and gay colours, can do much to bring about the extra production which is so badly needed at the present time. Modern industrial lighting, the result of research of E.L.M.A. members, combined with the investigations of industrial health authorities, can today provide conditions which inspire workers to greater effort and increased production.

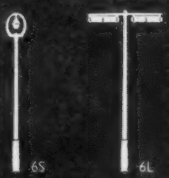
The E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, London, W.C.2, is maintained by the manufacturers of the following brands of lamps: OSRAM — MAZDA — ROYAL "EDISWAN" — SIEMENS PHILIPS — CROMPTON — METROVICK — ELASTA — CRYSELCO.

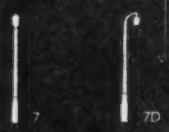
STANTON SPUN CONCRETE LIGHTING COLUMNS



From this to these...

The transformation which takes place every time sand, cement and granite become graceful Stanton Lighting Columns, is equalled by that brought about where these Columns form the basis of a lighting scheme. The skill and experience which govern manufacture of Stanton Columns, from the spinning machine (top picture) to the maturing yard, are the guarantee that their beauty is matched by their quality and utility. Full details of the wide range available will gladly be sent on request.





The Stanton Spun Concrete Lighting Columns illustrated have been passed by the Royal Fine Art Commissions, and bear the British Standards Institution's certification mark.

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THE STANTON IRONWORKS COMPANY LIMITED NEAR NOTTINGHAM

THE ATLAS 3500° WHITE FLUORESCENT LAMP

throws new light on display

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ATLAS 3500° WHITE gives a light that lies between the yellow-orange of incandescent lighting and the cool 'daylight' fluorescent lamp. Several large stores in this country have found it highly satisfactory, while in the U.S.A. it is one of the most popular 'colours' for display lighting. It gives definition without glare.

and it lasts for 5000 hours!

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send at once for samples

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Please send me ATLAS 3500° WHITE lamps as official order attached.

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ADDRESS .....

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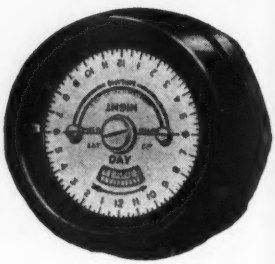
For Street Lighting

Control of Street Lighting means—in the more material sense—control by a "Sangamo" Synchronised Time Switch, for no other instrument can give such unfailing service. "Sangamo" Time Switches are an accepted standard in many parts of the country, since they alone offer such a precision standard of reliability and long life, and embody so many unique features of design. In addition to the Time Switches themselves, a range of post mounting boxes can also be supplied; details and prices will be sent on application. The co-operation of our Technical and Service staff is at all times readily available to Corporations, Urban and Rural Councils in connection with all street lighting applications.

The "Sangamo" Type SS Time Switch can be supplied to carry out the following sequence of operations. "On" at sunset and "off" at sunrise (or 45 minutes either side). Or, alternatively, "on" at sunset (± 45 minutes). "Off" at any time between 8.30 p.m. and 1 a.m. "On" between 3.15 a.m. and 8.45 a.m. "Off" at sunrise (± 45 minutes).



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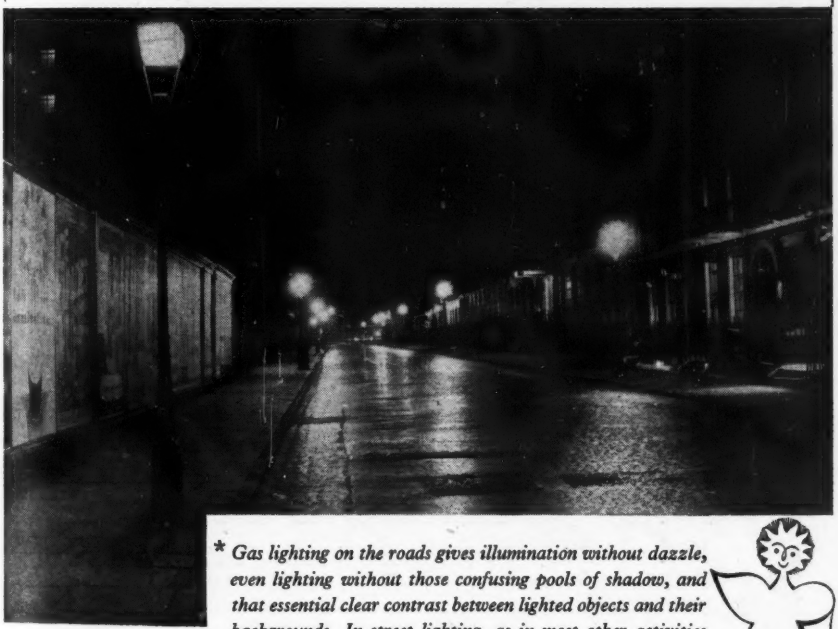
The cheering influence of modern gas lighting has spread to Guilford Street, Holborn. The existing lamp standards have been modernised by the addition of up-to-date gas lanterns. The units used have been specially designed for use at a mounting height of 15 ft. to meet the requirements of the upper range of group B lighting. They make the night brighter and safer for both motorists and pedestrians.



* *Gas lighting on the roads gives illumination without dazzle, even lighting without those confusing pools of shadow, and that essential clear contrast between lighted objects and their backgrounds. In street lighting, as in most other activities benefiting the public, you'll always find*

GAS AT YOUR SERVICE

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CONTROL UNITS

HIGH POWER FACTOR
STARTERLESS
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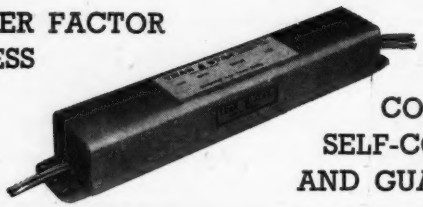

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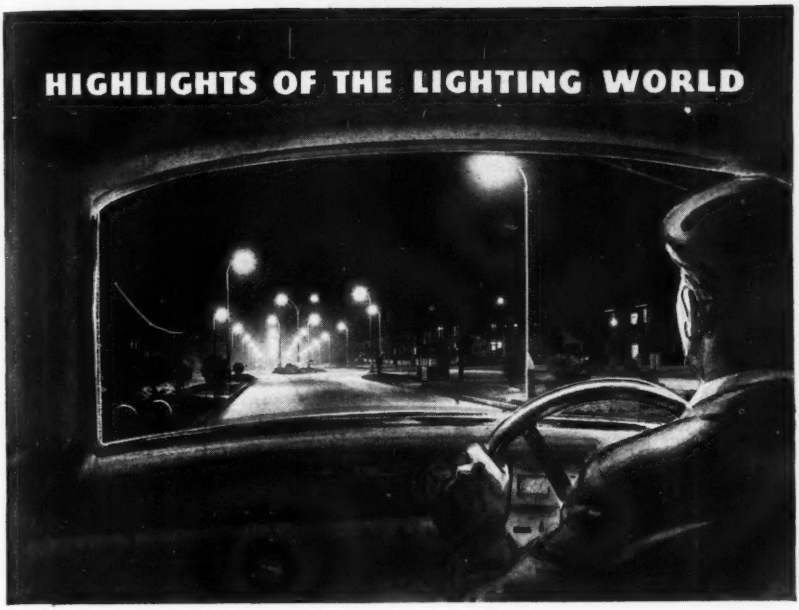
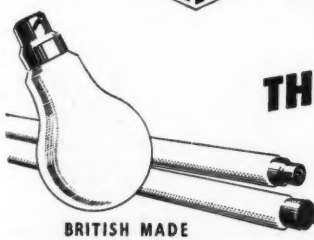


SIEMENS

SIERAY

STREET LIGHTING
for road safety



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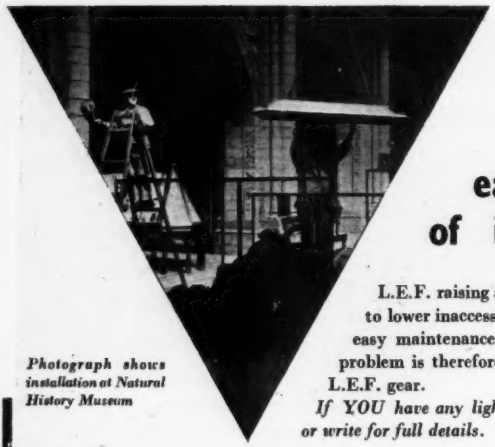

Photograph shows installation at Natural History Museum

easy maintenance of inaccessible lights

L.E.F. raising and lowering gear makes it possible to lower inaccessible lights to a suitable position for easy maintenance. A tricky and frequently costly problem is therefore overcome with the installation of L.E.F. gear.

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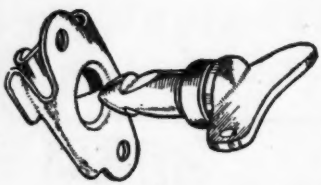

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This photograph, taken in Messrs. Booths & Colcloughs Ltd., modern pottery, shows Revo lighting installed by Messrs. Alliance Electrical Co. Ltd., and clearly illustrates the excellent results achieved by

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'TRUFOLITE'

REFLECTORS

For use with 1, 2 or 3 Tubular Fluorescent Lamps—4 ft. for 40 watts, 5 ft. for 80 watts.

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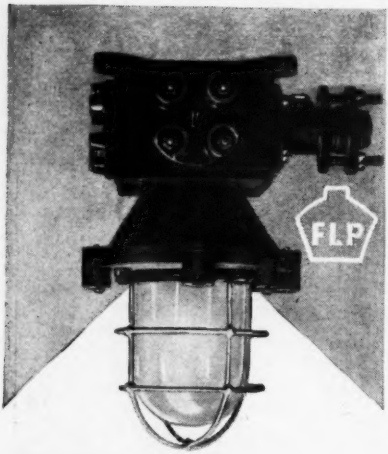

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The "Wigan" flameproof well glass fitting illustrated incorporates a new plug-in connection from the flameproof bush to the terminal block in the joint box. The fitting is manufactured in 3 sizes viz. 60, 100/150 and 200 watt and has been certified by the Ministry of Fuel and Power, Safety in Mines Research and Testing Branch, Buxton.

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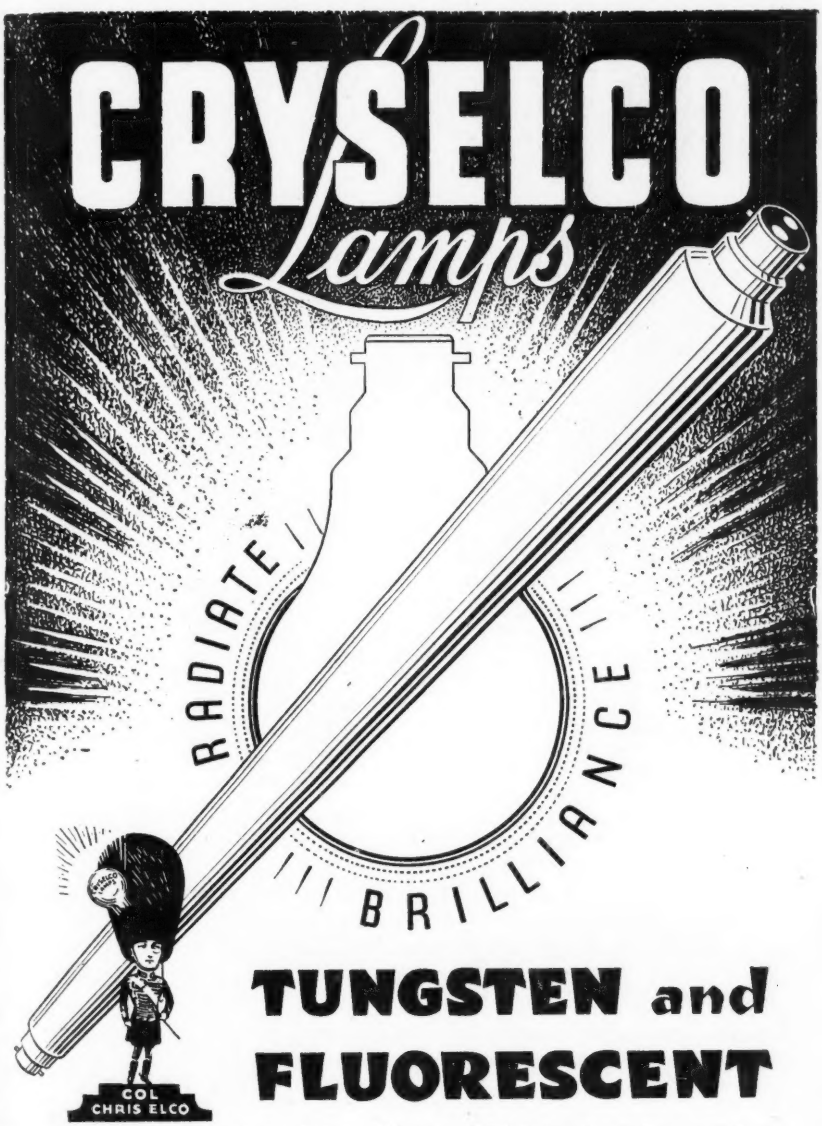
HEYES & CO. LTD., WATER HEYES ELECTRIC WORKS, WIGAN

dm HC 52

INDEX TO ADVERTISERS

Benjamin Electric, Ltd. .....cover ii
British Thomson-Houston Co., Ltd. cover iv
Chance Bros. ii
Crompton Parkinson, Ltd. iv
Cryselco, Ltd. .....cover iii
Donville (Birmingham), Ltd. vi
Edison Swan Electric, Ltd. vii
Ekco-Ensign Electric, Ltd. iii
Electric Lamp Manufacturers' Association .....cover i, ix
Foster Transformers and Switchgear, Ltd. 416
Gas Council xiii
General Electric Co., Ltd. i
Heyes and Co., Ltd. xviii
Horstmann Gear Co., Ltd. xiv
Inductive Appliances, Ltd. xiv
London Electric Firm, Ltd. xvi
Metropolitan-Vickers Electrical Co., Ltd. v
Oddie Bradbury and Cull, Ltd. xvi
Philips Electrical, Ltd. viii
Revo Electric, Ltd. xvii
Sangamo Weston, Ltd. xii
Siemens Electric Lamps and Supplies, Ltd. xv
Stanton Ironworks, Co., Ltd. x
Strand Electric and Engineering Co., Ltd. 422
Thermal Syndicate, Ltd. xvi
Thorn Electrical Industries, Ltd. xi

CRYSELCO *Lamps*



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BRIGHTER, FASTER, SAFER

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